Sir Sandford Fleming With the compliments of the Author

DEPARTMENT OF THE INTERIOR

CANADA

TRANSPACIFIC LONGITUDES

BETWEEN

CANADA AND AUSTRALIA AND NEW ZEALAND

EXECUTED DURING THE YEARS

1903-1904

BY

OTTY K[illegible]Z, LL.D., F.R.A.S.

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APPENDIX 3.

REPORT OF THE CHIEF ASTRONOMER, 1905.

TRANSPACIFIC LONGITUDES BETWEEN CANADA AND AUSTRALIA AND NEW ZEALAND, EXECUTED DURING THE YEARS 1903 AND 1904

BY

OTTO J. KLOTZ, LL.D.

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APPENDIX 3.

DEPARTMENT OF THE INTERIOR,
OFFICE OF CHIEF ASTRONOMER,
OTTAWA, CAN., December 30, 1905.

W. F. KING, Esq., LL.D.,
Chief Astronomer,
Ottawa.

SIR,—I have the honour to submit the final report on 'Transpacific Longitudes' carried out under my charge.

With me in the work was associated Mr. F. W. O. Werry, B.A., as observer, and he occupied Fanning and Norfolk isl[illegible]

Mr. F. A. McDiarmid, B.A., a[illegible] to the clock exchange at Bamfield, Vancouver Island, with the observatory [illegible]couver and the one at Fanning. He also computed all the transits.

I occupied Vancouver; Suva, Fiji; Southport, Queensland; and Doubtless Bay, New Zealand, besides the observatories at Brisbane, Sydney and Wellington for personal equation.

I have the honour to be, sir,
Your obedient servant,

OTTO J. KLOTZ.

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REPORT ON TRANSPACIFIC LONGITUDES BETWEEN CANADA AND AUSTRALIA AND NEW ZEALAND, EXECUTED DURING THE YEARS 1903 AND 1904.

NOTES ON THE BRITISH PACIFIC CABLE.

On December 1, 1900, articles of contract were made by Her Majesty's Government, Canada, [illegible] South Wales, Victoria, New Zealand and Queensland on the one part and the Telegraph Construction and Maintenance Company on the other, for the construction and laying of the Pacific Cable.

The contract called for the completion of the whole cable on or before December 31, 1902. The cable was finished two months earlier, and after undergoing the required test of a month, entered upon its commercial career on December 8, 1902.

Thus was the project, that had been advocated with persistence from some quarters for a quarter of a century, made an accomplished fact. The missing link of about 8,000 miles across the Pacific between Canada and Australia in the world's metallic girdle was now supplied.

Before the cable was laid a survey was made of the route and the character of the ocean bed examined.

From the survey the number of miles (nautical) of cable required for the different sections was as follows:—

From Vancouver Island to Fanning Island	3,654
" Fanning Island to Suva, Fiji	2,181
" Suva to Norfolk Island	1,019
" Norfolk to Queensland (Moreton Bay)	906
" Norfolk to New Zealand	513

The first section of the cable is about a thousand miles longer than any that had been laid before. This necessitated a considerable increase in copper for the conductor and in gutta percha for the dielectric. The working speed of a submarine telegraph cable depends on, and is inversely proportional to, the product of the total resistance of the conductor multiplied by the total electro-static capacity of the core, so that, other things being equal, the speed varies inversely as the square of the length of the cable. In the long section there were used 600 lbs. of copper and 340 lbs. of gutta percha per nautical mile. On the Fanning-Suva section 220 lbs. of copper and 180 lbs. of gutta percha; and on the remaining three sections the copper and dielectric were in equal proportions of 130 lbs. each.

In the neighbourhood of Fiji at a depth of 2,500 fathoms, a temperature of 34°·1 Fahrenheit was noted, being the lowest temperature taken during the survey. There is very little difference in the temperature of the ocean at great depths, say below 3,000 fathoms, over a great extent of the earth's surface, the temperature being only a few degrees above freezing point, or 32° Fahrenheit. The greatest depth, 3,070 fathoms, about three and a half miles, was found on the Fiji-Fanning section, where the bottom specimens consisted principally of radiolarian ooze. This ooze is found at the greatest depths, and was obtained by the *Challenger's* deepest sounding in 4,475 fathoms. The United States steamer *Nero* sounded in 5,269 fathoms, 6 miles (this last being the deepest sounding recorded in the ocean), and the material brought from the bottom was radiolarian ooze.

Of the 597 samples of sea bottom obtained on the Pacific Cable survey, 497 were such that they could be divided into distinct types of deposits. It was found that:—

294	samples	referred to	globigerina ooze.
65	"	"	red clay.
43	"	"	radiolarian ooze.
45	"	"	coral mud or sand.
27	"	"	pteropod ooze.
12	"	"	blue or green muds.
11	"	"	organic mud or clay.

The pressure at a depth of 3,000 fathoms, in which a considerable portion of the Pacific Cable is laid, is about four tons to the square inch. When the cable is being laid at such depths, it will be approximately twenty miles astern of the ship before it touches the bottom.

Deep sea cables last longer in the tropics than in the northern oceans. The reason is to be found in the fact that in the tropics marine life, from which globigerina ooze is derived, is more abundant than in the more northerly or southerly waters. It is the sun and the warm surface water that call into life these countless globigerina, which live for a short space, then die and fall to the bottom like dust, making such a good bed for the cable to rest in. In the Arctic currents, where the surface is cold the water does not teem with life in the same way as it does in the tropics, and consequently there is less deposit on the bottom of the ocean.

A submarine cable consists, first of a core, which comprises the conductor, made of a strand of copper wires, or of a central heavy wire surrounded by copper strips as in the Pacific Cable, and the insulating covering, generally made of gutta percha, occasionally of india rubber, to prevent the escape of electricity. As far as cabling is concerned, this is really all that is necessary, an insulated conductor. This, however, would not, in the first place, be sufficiently heavy to lay in the ocean, and secondly, would be too easily injured and destroyed by the many vicissitudes to which it would be subjected. For this reason, a protection in the form of a sheathing of iron or steel wires surrounds the core; the nature, size and weight of the sheathing being dependent upon the depth of the water and kind of ground over which it has to be laid. The deep sea section, being the best protected from all disturbing influences outside of displacement of the earth's crust by earthquakes or volcanic action, is naturally the one of smallest dimensions; and for the shore end, which is exposed to the action of

the waves, to driftwood, to the grinding of ice in the more northerly latitudes, and to the danger of anchorage, especially of fishing boats, the sheathing must be very heavy. So that while the deep sea cable is somewhat less than an inch in diameter, that for the shore ends is nearly 2½ inches in diameter. The action of the waves is limited to a depth of only about 13 fathoms, so that their influence on the cable, manifested by wear and chafing, is confined to the shore end.

The Pacific Cable is equipped with the most modern apparatus at the various stations, and the cable is worked duplex, that is, messages are sent and received on the same cable at the same time.

Canada had carried longitude work from Greenwich across the Atlantic and thence to Vancouver. The completion of the British Pacific Cable offered an opportunity for continuing the work across the Pacific in the interests of navigation and geography, besides tying for the first time longitudes brought eastward from Greenwich with those brought westward, making the first longitude girdle round the world.

In October, 1902, the Honourable Mr. Clifford Sifton, Minister of the Interior, authorized the carrying out of the Transpacific longitudes, and the Governors of the South Sea, Australia and New Zealand were respectively officially notified thereof.

In preparing the programme for carrying out the work, the climatic conditions of the various stations to be occupied were studied so that the most favourable times and seasons might be chosen. It was found that Suva, Fiji, was the governing factor, as it was by far the rainiest place of the series.

Besides the transit outfit, I carried, too, a half-seconds pendulum apparatus, and a Tesdorpf magnetic instrument, the latter similar to the ones furnished to Drygalski of the *Gauss* on his Antarctic expedition.

ITINERARY.

Mr. Werry left Ottawa on February 27, 1903, and proceeded to San Francisco, whence he sailed for Samoa, where he took the northbound steamer for Fanning island. The southbound steamers in passing Fanning do not call there. In the latter part of March, Mr. McDiarmid and I proceeded to Bamfield, Vancouver island, the eastern terminus of the Pacific Cable. After installing the sideral clock and its connection with the cable, I returned to the Vancouver observatory to begin observations. Bamfield, where no observations were taken, was simply used as a clock exchange station for making comparison between the Fanning and Vancouver clocks.

By the end of April a satisfactory number of observations had been obtained at Fanning and at Vancouver, and the first link of the Transpacific longitudes completed.

I took passage on the Canadian-Australian steamer *Miowera*, and sailed on May 2 for Suva, Fiji. We called en route at Honolulu. Here were met the two American astronomers, Mr. Edwin Smith and Mr. Fremont Morse, who were engaged in the determination of the difference of longitude, San Francisco-Honolulu. Suva was reached May 20, and immediate steps were taken for the erection of the pier and the observatory. The Fanning-Suva longitude was completed on June 24. It may be stated that as Suva is just west of the 180th meridian, and Fanning east of it, the dates for the observations of the same night differ by a day. Mr. Werry left Fanning on June 27 for Norfolk island some 3,000 miles distant. This necessitated a rather circuitous route of about 7,000 miles for lack of suitable steamer connections. He had to return to Honolulu thence to Samoa, Auckland, New Zealand, Sydney Australia, and finally to his destination, which he reached in the beginning of August, occupying about six weeks to reach the cable station at Norfolk island. During this interval I made pendulum and magnetic observations at Suva, and also paid a visit on invitation of Roko Kandavu, grandson of the great cannibal king, Cakobau, the present ruler, at the old Fijian capitol on the small island of Bau, some 20 miles from Suva.

About a month was occupied in determining the difference of longitude, Suva-Norfolk. On September 7 I sailed on the *Aorangi* for Brisbane, where we arrived on Saturday, the 12th. On the following Monday I proceeded by rail with the astronomic outfit of many cases to Southport, the cable station, fifty miles south of Brisbane.

Mr. H. C. Russell, government astronomer at Sydney for New South Wales, hearing of my arrival, immediately wired his hearty co-operation in connecting Sydney with Southport. Similar co-operation was readily granted by Mr. A. A. Spowers, Chief Surveyor for Queensland, with the Brisbane observatory in charge of Mr. T. D. Fraser. By September 25 the pier and observatory were built and observations begun. Southport formed a unique station, for nightly clock exchanges were had in succession with Brisbane, with Norfolk and with Sydney, at each of which time observations were being taken. It was on September 29 that the first mutual observations and clock exchange were had with Sydney, and so this night may be considered as the one when for the first time longitude from the west clasped hands with longitude from the east, and the first astronomic girdle of the world was completed.

By October 16 the last link, Norfolk-Southport, of the direct Transpacific longitude was completed. Mr. T. D. Fraser and I observed for personal equation at Southport and at the Brisbane observatory. Magnetic observations at Southport were also taken. On November 3 I arrived at Sydney, and after observing for personal equation, with the two observers, Mr. H. A. Lenehan, acting government astronomer, and Mr. W. E. Raymond, left on November 7 for Wellington, New Zealand. Here I was met by Sir James Hector, the former director of the observatory, and by Mr. Thomas King, who now has charge of the time observations. The Premier, the Honourable R. J. Seddon, extended every facility the government could offer to further the success of the work. Observations were made for personal equation by Mr. King and myself. After making the necessary arrangements for subsequent clock exchange signals at the observatory, I left for the cable station at Doubtless Bay, at the north end of New Zealand, going by rail to New Plymouth, thence by steamer to Onehunga, across the narrow isthmus by rail to Auckland and thence by steamer to Mangonui, the most northerly port on the east coast. From there I had to drive over an execrable road some miles to the cable station. Here a pier and observatory were built similar to the ones at Suva and Southport. Longitude observations were begun on December 3 and finished on December 19. Before leaving this station a set of pendulum observations was obtained, and the magnetic elements were also determined.

Returning to Wellington, another set of personal equation observations was taken, and similarly in Sydney in January, 1904.

This completed the work of the Transpacific longitudes.

I wish here to express thanks for the hearty co-operation of the chief electrician of the Pacific Cable and of the superintendents at all the stations; of the superintendents, Mr. Hesketh, of the government telegraphs in Queensland; Mr. Young, for New South Wales, and Mr. John Logan, for New Zealand. Mr. G. A. Buzacott, Deputy Postmaster General of Queensland; Mr. J. Dalgarno, for New South Wales, and Sir Joseph Ward, Postmaster General of New Zealand, kindly placed the use of the respective telegraph lines at my disposal for the nightly clock exchanges.

At the Wellington observatory batteries and telegraph instruments had to be installed for the clock exchanges with Doubtless Bay. This was done by Mr. Buckley, government electric' n, who also kindly attended every night during the campaign at the observatory to the exchange of signals. In short, wherever and whenever any assistance was required it was readily and cheerfully extended, and the success of the work is in no small measure attributable thereto.

The number of stations between Vancouver and Australia, as well as between Vancouver and New Zealand, is odd, and as the two observers occupied alternate stations, the terminal stations, Southport and Doubtless Bay, are each free by this means from personal equation.

KLOTZ—INSTRUMENTAL EQUIPMENT.

Transit.—The transit (Fig. 1) is by T. Cooke and Sons, and known as No. 504 of their catalogue, 1900, with slight modifications. This instrument was specially ordered for the Transpacific longitude, and was received only a short time before departure for Vancouver, where it was mounted for the first time, and the large inequality of pivots discovered. It has an object glass of three inches, clear aperture, and is mounted in a tube of double conical shape with dew-shade; focal length about 36 inches, axis 1¼ inches in diameter, Y's 1⅛ inches in width; the support of each end of the axis is two cylindrical segments having arcs ¾ inch long.

The telescope is provided with two 6¾-inch setting circles reading by verniers to 20 seconds of arc. One of these circles is provided with a special arm for carrying the latitude level, when using the transit as a zenith telescope. Above the level there is a device for an attachable mirror, a strip of silver glass set in a metal frame. In using the transit as a zenith telescope the level readings cannot be satisfactorily read for stars near the zenith, as one end of the bubble will be directly behind one of the transit standards. To avoid parallax in reading the level, the mirror, secured at an angle of 45 degrees, and at the height of the eye, overcomes the difficulty.

A striding level is provided. The vial rests on cork tips, and is retained in position by light cork tipped springs. There is a glass covering to prevent sudden change of temperature of the vial. A single wooden knob on the level frame serves for handling the striding level. On account of the long legs it was found necessary to attach lateral legs to prevent accident from toppling over through gusts of wind or other cause. A dew-cap 6 inches long is used when observing. The eye-piece attachment carries a micrometer for the movable thread used for latitude work. The micrometer is divided into a hundred parts, equivalent to about 56 seconds of arc, so that by estimation to tenths of a division, about six-hundredths of a second of arc may be read. The eye-piece attachment with micrometer may be turned through 90° from the ordinary position when observing transits, in order to make the movable thread available for measuring zenith distances in latitude work. Instead of having a comb for counting the revolutions of the micrometer there is a small, toothed, geared and numbered wheel outside to effect the same purpose. This has the advantage of obviating erroneous counting which may happen with the comb in counting from left to right, instead of from right to left or vice versa.

Of the different eye-pieces with which the telescope is provided the same rectangular (erecting) eye-piece was used throughout. The eye-piece is set in a cross-slide with quick-traversing screw and milled-head.

There are on the diaphragm thirteen spider threads, two outside ones and then two groups of three each placed symmetrically about a middle group of five threads. The equatoral interval between two adjoining threads in a group is about 1·6 seconds of time. The illumination of the threads was effected through the hollow axis by an oil lamp, placed on an arm 9 inches long. To prevent unequal heating of the axis, a lamp was placed at each end of the transit axis. Lucca oil is found the most satisfactory for burning in the small instrument lamps.

The transit was supplied with reversing apparatus. The cast-iron stand rested on a base-plate and was supported by three large screws, one at one end and two at the other, fitting into spherical holes in the base-plate. For meridional adjustment two opposing screws at the foot of the stand and near the supporting screws acted on a projection on the base-plate, the levelling was done by the single supporting screw at one end. The base-plate was not bolted to the cement capping of the pier. The weight of the whole instrument and plate was sufficient to retain the latter in a permanent position with reference to the pier.

Clocks.—Two clocks or rather chronometers were carried. They were adjusted to sidereal time. Both had break-circuit electrical attachments.

Dent No. 48419 had two-second breaks at the even seconds, omitting the 58th second break in order to indicate the 60th or minute break.

To the inside of the outside case were attached maximum and minimum thermometers and an ordinary thermometer within the chronometer box proper. One dry cell was generally found sufficient for the clock circuit, and would retain its efficiency for two months. During the day time when not observing, the clock circuit was of course left open. The clock at each cable station was placed in one of the 'artificial line' cabinets, so that its temperature might be as uniform as possible. The fluctuation in temperature during the twenty-four hours was small, being confined within about two degrees Fahrenheit. At Vancouver the chronometer was kept in a small brick vault near the observatory, used for storing the powder for the signal gun, a quarter of a mile distant, which is fired daily at 9 p.m. Pacific standard time. Insulated copper wire connected the clock with the switchboard in the observatory, hence with the chronograph circuit; and by another set of wires with the sounder on the pier of the cable instruments, by means of which, as more fully explained elsewhere, the clock was made to record its beats by a special siphon on the cable fillet of paper.

The clock was wound daily at 4.30 p.m.

Bond No. 516 made two second breaks also; instead of omitting the 58th second break, however, a break for the 59th second was interpolated to identify the following one for the full minute.

Chronograph.—A Fauth (Saegmüller) barrel or cylinder chronograph was used. The cylinder was 6¾ inches long and 4 inches in diameter. It was geared to two speeds, but the slower speed of one revolution per minute was the one always used. A Waterman fountain pen answered the purpose as recording style, but it requires attention. The perversity of some things at times seems inexplicable.

The pen, being actuated by the small armature of the magnet of the chronograph, and the electric circuit of the latter by the clock, also by the observing key, records both the clock and star transit.

It was customary to use one chronograph sheet for each position of the instrument, so that for a complete set there would be four sheets for a night's observations, and an extra sheet when there was an exchange of clock signals over land lines. The chronograph sheets are infinitely more convenient for scaling a set of observations than the Morse fillet so common in the European observations. For subsequent reference too the sheet is vastly superior to the yards or fathoms of fillet.

The measurements on the chronograph sheets were made by means of a convergent-divergent glass scale, covering the two-second spaces, and dividing the same into tenths of a second, which by estimation were read to hundredths. Fig. 2 shows one of the chronographs used.

Levels.—Both the latitude and striding levels used were supplied with the transit by T. Cooke & Sons.

Their value was determined before and after the work by means of a level-trier, 114·40 inches between the pivots, and the Whitworth micrometer screw for raising and lowering one end of the trier read directly to one-thousandth of an inch. Determinations for value of one division of level were also made by placing the level longitudinally on the telescope tube of transit No. 2, then comparing the displacement of the bubble with the corresponding angular movement of the telescope as measured by the micrometer on some distant fixed object.

The method by level-trier is more accurate than the one by the micrometer, as the latter involves the uncertainty of constant bisection with the micrometer thread.

Electrical Apparatus.—The switchboard which has been used for many years very satisfactorily in connection with the Canadian transcontinental longitude work, was used at every station. For clock exchange by cable all its parts were not required; it then only served for the observations themselves by making the necessary connection between clock, chronograph and observing key.

However, at Vancouver, Southport and Doubtless Bay, where clock exchange signals were made over land lines and the conversation was done over the wires from the observatory, all parts of the switchboard were brought into requisition.

The accompanying diagram (Fig. 3) will illustrate the various parts and connections of the switchboard.

When observing, the switch is to the left, and plug 1 is in. The chronograph circuit is broken by the chronometer at the points of the clock relay, as well as by the observing key.

For simply talking over the line the switch is to the left, plug 2 in, plug 3 out, and also plug 8 out if the sounder is to be used. Experienced operators do not need the sounder but read off the relay.

For clock exchange, both clocks (of the two stations) beating simultaneously over the wire, the switch is put to the right, plugs 1 and 2 out; 3 may be out or in. When 3 is in, the talking relay is cut out. In clock exchange the main line current passes over the points of the clock relay and is there broken; similarly the distant clock breaks the local chronograph circuit at the points of the signal relay.

For arbitrary signals, sent with the break-circuit signal key, the switch is to left and plugs 1 and 2 out, so as to throw the chronograph circuit over the points of the signal relay. Under all conditions the chronometer always records on its own chronograph.

When the switch is to one side, the opposite points are in contact. The switch separates them, and changes thereby route of current. One dry cell (Mesco) is sufficient for the clock circuit. This is always independent of any other current, and to protect the points of clock contact only one cell is used.

For the circuit of the observing key and chronograph two or sometimes three cells are used.

Cable Attachment.—From former experience it was found undesirable to have a direct connection between the clock and the cable siphon, *i.e.*, to have the clock recording directly by means of the cable siphon. It is better to have an independent clock siphon tracing a line parallel to the one of the cable siphon.

To obtain the local clock record or two-second beats on the cable fillet, an ordinary sounder (Fig. 4) was provided with a 4½-inch long threaded rod attached vertically to one end of the sounder arm. Over the rod fitted loosely an oval ring held in position by two opposing screws and also by two nuts, one above and the other below the ring. The heads of the screws were perforated to admit of centering and fastening the silk fibre, to be spoken of presently. The sounder was screwed on a small board and the latter securely attached to the pillar on which the cable instruments are set, as it was found that by placing the sounder on the table the vibrations to which it was subjected by walking or other causes, made the siphon record unsatisfactory. On the brass frame (of the cable instrument) carrying the ordinary cable siphon was stretched another thin wire to which was attached a siphon which was connected by a raw silk fibre with the rod of the sounder arm, so that the siphon responded to the pulsations of the sounder and hence when filled with ink would leave a record on the cable fillet.

The recording of this siphon differed [illegible] om that of the ordinary cable siphon, in as much as it dragged a continuous line o[illegible] fillet, while the other makes necessarily a dotted line, produced by the small vibra[illegible] pping the frame. The magnetic effect, produced by the weak current used on cables, and which actuates latterally the cable siphon, is too weak to permit the siphon to rest permanently on the fillet, it could not draw it aside, so the siphon is kept just above the paper and by means of the vibrator is made to deposit drops of ink—about 60 per second—and thereby leave a record.

Before attaching the silk fibre to the sounder rod and siphon it was subjected to a constant pull by means of a small weight for a day in order to remove its elasticity sufficiently to permit of instantly responding on the siphon to the movements or pulsations of the rod. The tension of the fibre was adjustable by means of the two small opposing screws in the oval rings of the rod.

The local clock record on the cable fillet was necessary in order to be able to interpret the arbitrary signals sent from the other observing station and recorded by the cable siphon. In receiving signals there were two records on parallel lines on the fillet, the signals as shown by the cable siphon, and the clock beats shown by the other siphon. The trace of the latter was the foot-rule, so to speak, or scale for measuring the other. The two-second breaks in the line drawn by the clock siphon were projected vertically by a fine pencil line on the line of the cable siphon and the relative position of the arbitrary signals measured by a glass scale, similar to the one described, but somewhat larger, as the two-second breaks on the fillet were made considerably larger than those on the chronograph sheets. The speed of the fillet is adjustable by the small motor.

Although the siphons were generally placed fairly opposite each other, that is, in the same perpendicular to the fillet, yet it was necessary to know their parallax. To attain this end the local clock circuit was put in connection with one of the cable keys, the one (positive) used for sending arbitrary signals. A special arm was attached to that cable key so that when the cable key was depressed to make circuit and send a signal into the cable, the arm would at that moment break the local clock circuit, hence record the time on the fillet. By comparing the relative positions to a vertical of the break made by the cable siphon with that of the other siphon for an arbitrary signal, the apparent parallax of the siphons is obtained. To this parallax there may be a small outstanding correction due to want of perfect adjustment, that is, that the make of the cable key absolutely synchronizes with the break on the clock circuit. To obtain the absolute parallax the metal frame carrying both siphons was given a slight sharp tap, generally with the back of a pocket knife. By this means there was a momentary simultaneous displacement of both siphons and the parallax obtained, and by comparison with the above, an adjustment, if necessary, made.

The correction was always a small quantity—if anything at all—and about one-hundredth of a second of time.

Observing key.—This was an ordinary American telegraph key mounted on a small piece of wood. The spring adjustment was made weak, and the platinum points about a fortieth of an inch apart. The same conditions were maintained throughout the work. The moment the key was touched the circuit was broken and the transit recorded, independent of the spacing between the points of the key, which is not the case in a make-circuit key.

SYSTEM OF WORKING.

Programme.

It was decided that for each final differential longitude there should be five mutually complete nights or their equivalent.

Time set.—A complete night's programme comprised twenty-eight stars, divided into four sets of seven stars each. One of the seven being a polar, while the others were distributed between the zenith and an equatorial zone.

Two of these sets—one clamp east and one clamp west—comprised a time determination, so that each night, when clear, there would be two independent time determinations, and a measure of the individual hourly clock rate obtained, beside the daily rate shown by the observations of successive days.

For the northern hemisphere the Berliner Jahrbuch has generally been used for the selection of stars, but for the southern hemisphere the British Nautical Almanac furnished the most suitable stars. Both were supplemented by the American Ephemeris and Connaissance des Temps. On account of the difference in longitude between any two stations, and for other reasons it was not practicable for the two observers to use the same sets of stars for the purpose of eliminating errors in right ascension, which in the standard stars alone used is supposedly a very small quan-

tity. The programmes were always so arranged that each observer would, with clear sky, have completed his first time determination, that is, would have observed one set clamp east and one set clamp west, before the time of exchange, generally at 9.30 p.m., of clock signals. These signals would therefore fall between the first and second independent time determinations. It is all-important that the respective clock errors be accurately known at the time of exchange of clock signals. This is best obtained and assured when there is a time determination immediately preceding and one immediately following such exchange. Through clouds or rain, or other unpropitious weather it was not always possible to obtain the time determination when desired.

Exchange on Cable.—Along the whole system of the Pacific cable Greenwich mean time is used for the commercial work. For Fiji through which runs the antimeridian of Greenwich, the Greenwich mean time 12 hour clock dials would practically show local time for Suva. It was desirable in the cable offices that the time for exchange of clock signals be fixed at some definite time so that the officers could govern themselves accordingly and have the spare cable instrument in readiness at the appointed time. The time was so arranged that the westerly observer had time to obtain his first time determination before the exchange. In the tropics observing may be begun almost immediately after sunset, as there is little twilight. The exchange consisted in each observer sending alternately not less than thirty arbitrary signals at irregular intervals, averaging about two seconds apart, the interval being always sufficiently long to permit the siphon to have well resumed its normal position in tracing the zero line of dots on the fillet. The signals having been mutually and satisfactorily received, the record of the night's work and of the preceding night was mutually communicated, and this ended the use of the cable for the night. If all went well, the whole exchange of signals and communications would occupy less than ten minutes. This was, however, not always the case; the ink in the siphon might give trouble, or the vibrator, or some other vicissitude for which one must always be prepared not only at the cable instrument, but also in the observatory.

Throughout the whole work, received signals were scaled by Klotz on the cable siphon record, by projecting the 2 second breaks of the clock on the lower or clock siphon record upon the upper one. This method was preferred to projecting the received signals (beginning of deflection of cable siphon) on the lower line to avoid obliterating or obscuring by a pencil line as ordinate the dot or dots (vibration of siphon) indicating the arrival of the signal. In the method pursued, after adjusting the glass scale to cover the intersection of the ordinates from the clock breaks with the zero line of the cable siphon, one could deliberately determine the first indication of the cable siphon leaving its zero line of undisturbed position.

The scaling of the signals sent, which were recorded by both siphons, was always done on the clock siphon record, hence it is necessary to apply to all scaling of signals received, which were recorded of course only on the cable siphon, the parallax of the cable siphon. This parallax was readily obtained from the signals sent, because in that case we have the record for each signal by the two siphons. To test the adjustment of the cable key with the local clock circuit, *i.e.*, whether the two siphons recorded simultaneously, the cable key make and the clock circuit break, the frame carrying the two siphons was lightly tapped after the exchange of signals thereby making simultaneously a break in the two lines made by the siphons, and the absolute parallax expressed in time found. If the apparatus is well adjusted, this absolute parallax is identical with the one obtained as described above. When a difference was found it was confined to about one-hundredth of a second.

Mr. Werry invariably scaled the cable siphon record both for sending and receiving signals on the clock siphon line by projecting the same on that line. The parallax of the siphons was obtained in a manner similar to the one described above.

The accuracy with which a comparison between two clocks or chronometers can be made by means of a cable, is practically only a matter of careful scaling of the time signals on the tape. So that with the tape running out approximately an inch

a second it is found that an exchange of thirty signals gives a probable error for the mean difference of the two chronometers of less than ±.002. Small as this quantity is, it includes error of scaling, irregular running out of tape, irregularity of clock beats, and differential rate.

Compared with the many other quantities—star places, level readings, temperature with its hidden effects on instrument and chronometer, errors of observation, personal equation—entering into the determination of the difference of longitude, the probable error of an exchange of time signals is almost a vanishing quantity. The same remark holds true for an exchange over land lines. Fig. 5 illustrates a cable record, both receiving and sending.

Clock Exchange on Land Lines.—Land line exchanges were made between Vancouver and Bamfield, Southport and the observatories at Brisbane and Sydney, the former fifty miles distant by wire, and the other 753 miles. Also between Doubtless Bay and the observatory at Wellington, 704 miles. The exchanges were effected without the interposition of relays on the line.

It was customary to allow both clocks to record over the wire at the same time and record on the chronographs of the two stations. This was a mere check on the actual exchange by arbitrary signals and to show the relative position on the chronographs of some one minute (the 60th second) of the one clock and some one minute of the other clock. Experience has long shown that a more accurate comparison between two clocks can be made by arbitrary signals, that is by breaking the local clock circuit as shown on the chronograph, and by that same depression of the key, breaking the main line and hence sending a signal to the distant station there to be recorded on the chronograph, than by simply allowing the clocks to record over the line. The particular merit of the arbitrary signals lies in the fact that in scaling the chronograph sheets the mind is and remains unbiased in making the measurements, whereas when scaling the record of the two clocks recording simultaneously on the chronograph, the mind involuntarily becomes biased after making one measurement. We know in advance what the remaining measurements should be. It is impossible to get rid of the influence of knowing in advance what to expect. This undesirable condition in exchange of clock signals is obviated by adopting the method of arbitrary signals. The measurements on the chronograph sheets as well as on the cable fillets were read to the one-hundredth of a second of time.

At the three observatories, Brisbane, Sydney and Wellington the Morse register with fillet of paper and two styles was used for recording the exchange of clock signals. It is somewhat surprising how tenaciously this form of chronograph is maintained not only at these observatories (Sydney had a drum chronograph too) but also at those in Europe. The cylinder chronograph is to one who has used both so manifestly superior for convenience of reference and reading and saving of time that it is difficult to understand why the Morse form is retained.

Rate.—Rate is one of the most difficult problems with which we have to deal in longitude work. It is not the magnitude of the rate, although a small rate is very desirable, but the constancy. This is the crux. A chronometer may have an apparently constant daily rate, yet the hourly rate for the twenty-four hours may and does vary. Again the rate is not the same when the current is on, as when it is off; the former condition obtaining when observing, and the latter the rest of the day. The rate deduced from two indepedent time determinations of the same night, when the temperature is practically constant for the clock during the time of observation, and the clock is in circuit with the battery only during that time, is seldom, if ever, the same as that obtained from day to day observations.

In our programme we have two independent time determinations for each night. Each set of transits is reduced to the epoch of the mean of the times of transit of the stars comprising the set. The rate which is applied for each transit to the mean epoch, and for which some magnitude must be assumed, is practically a vanishing

quantity in the resulting clock correction. The ideal time of exchange would be at that epoch, when the effect of rate is eliminated. But for various reasons this is found to be impracticable. In the programme then of two independent time determinations, for obvious reasons the exchange was arranged to take place about midway between the two epochs. An interpolation between the two epochs gives the clock correction at the instant required, that of the signals. This assumes that the rate is constant during the interval, and is represented by a straight line. If extrapolation is necessary, as sometimes occurs, the rate value has less weight.

Transmission Time.—On the assumption that the time of transmission is the same in both directions and that the chronometers have the same rate, the difference of records at two stations of the exchange of time signals will represent twice the time of transmission.

We are obliged to assume that the transmission time is the same in both directions, but to the difference of the records of exchange of time signals there must be applied the relative rate for the interval between the means of the times of the two exchanges. This interval is confined to about two minutes.

From the two independent time determinations made at each station on the same night the hourly rate of each chronometer when in circuit is obtained. The algebraic difference of these hourly rates gives the relative hourly rate of the two chronometers and the proportional part for the above interval is the quantity entered in the column 'Relative rate' of Table. . . . . .

On exchange by land-lines, it will be seen, referring to the diagram of the switchboard that the deduced transmission time is free from any retardation by the signal relays or by the secondary circuits of the chronographs. The effect upon the comparison of the clocks of retardation by the signal relays and secondary circuits will disappear in the mean of the two exchanges provided the sum of the retardations by signal relay and secondary at one station is equal to that at the other. This condition is, however, not necessary for finding the time of transmission.

Personal Equation.—Fortunately for the connection between Canada (Vancouver) and Australia (Southport), also New Zealand (Doubtless Bay), the personal equation between the two observers was eliminated. This is, of course, on the supposition that the personal equations remained constant. As the climatic conditions, as far as temperature was concerned, and the surroundings were favourable for personal comfort, there was no *a priori* reason for suspecting any change during the campaign in the personal equation. The elimination referred to was due to the fact that the number of stations was odd, and that the observers occupied alternate stations. I occupied the terminal and middle stations, while Mr. Werry occupied the other two—Fanning and Norfolk Islands,—and for these two stations differential personal equation must be applied. To determine such we observed on our return with the same two transits of the Transpacific longitude, on several nights in a manner identical with that at work in the South seas, and under similar climatic conditions. It may be remarked that it was impracticable before leaving Ottawa to observe for personal equation. In the first place it was winter, thermometer below zero, and secondly my Cooke transit had not yet arrived when Mr. Werry set out for Fanning island, via Samoa.

For the longitude of Brisbane, Sydney and Wellington, I observed with each of the observers at the respective observatories, by determining the clock correction for the respective common epochs.

Instrumental Constants.

Thread Intervals.—These were determined by both instruments by observing the transits of slow-moving (polar) stars and the intervals were all referred to the mean and not to the middle thread. The times of transit are corrected for level (if any change of level has taken place during the transit) and for rate. Multiplying the

time interval of any thread from the mean thread by the cosine of the star's declination gives the equatorial interval for the same. For circumpolar stars, whose motion during the time of transit from one thread to another is sensibly an arc of a circle the interval must be further multiplied by the cube root of the cosine of the hour angle of the star for the respective threads.

The following are the values of the equatorial intervals for Klotz transit, determined from transits of α Crucis, γ Trianguli, α Trianguli and β Chamaeleontis.

Clamp East.

	s.
1	9·939
2	8·273
3	6·690
4	3·279
5	− 1·640
6	+ 0·636
7	+ 1·576
8	+ 3·200
9	+ 6·662
10	+ 8·352
11	+ 9·995

For the Werry transit, the values determined from transits of λ Centauri, α Crucis, Groombridge 1930 and 8 Draconis are:—

Clamp East.

	s.
1	13·209
2	−11·903
3	− 9·573
4	− 4·794
5	− 2·196
6	− ·110
7	+ 2·454
8	+ 4·681
9	+ 9·591
10	+11·906
11	+14·153

Inequality of Pivots.—The Klotz transit was received from the maker in the dead of winter and just prior to leaving for the Pacific so that no opportunity was afforded to determine any of its constants at Ottawa.

The inequality of pivots was determined both by special series of observations and also from the many level readings just before and after reversal of transit in the daily (clear nights) time determinations.

In this transit there was a considerable change in the inequality of pivots from April to December. For Vancouver and Suva the values are identical, thence onward there is an increase for Southport and still more for Doubtless Bay. The cause of the change is not apparent. Before beginning observing in Southport I removed with great difficulty the plug carrying the lens in the clamp end of the axis as the inner surface of the lens was covered with brass filings. In re-inserting the plug I did not get it quite 'home.' This might perhaps have affected the diameter of that pivot. Whatever the reason, the quantity was accurately determined and applied to the level correction.

The mean value for Vancouver of seven determinations gave for p the pivot inequality correction $^s.080$, the inequality being twice that quantity.

A similar determination at Suva gave p $^s.080$.

At Southport a double series was taken, one by continuous readings on many reversals, the other from many nights level readings during the time of transit observations. From these we obtain p $^s.117$.

At Doubtless Bay the value was obtained from level readings extending over the whole period of time determinations in December and the resulting value for the correction of inequality of pivots is p $^s.151$.

All the corrections are additive for clamp east, the axis opposite the clamp being the larger. The respective values of p were applied for each station.

Level.—The value of the striding level of Klotz transit was obtained from two series of readings on different d by placing the striding level longitudinally on the telescope of the Werry transit. The telescope was clamped in a position to allow the bubble in the striding level to play near one end of the tube. By means of the micrometer and its thread a reading was taken on a distant object. Then by means of the tangent screw of the telescope, the latter together with the level was displaced. This displacement was measured by the micrometer screw and expressed in angular measure. Repeated and satisfactory measurements were thus obtained.

The mean value of one division of the level at 68° F. is $^s.085$.

By the use of the level trier the mean value the striding level (a Pessler) of the Werry transit was found to be $^s.100$.

Micrometer.—The value of the micrometer of either instrument was not required in the longitude work, only for the latitude determinations, by using the transit as a zenith telescope and observing by Talcott's method. The value of the micrometer was obtained from a series of transits of slow-moving stars over the micrometer thread, set in advance at intervals of five revolutions. The times of transit were corrected for rate and for hour angle The mean of the time intervals was taken and reduced by multiplying by the cosine of the star's declination.

From such observations the value of one revolution of the Klotz transit micrometer was 56″.878.

That for the Werry transit is 60″.556.

Diurnal Aberration.—The correction for diurnal aberration was obtained for each star by the usual formula $-^s.0207$ Cos. ϕ Sec. δ and applied to the time of transit. ϕ and δ being the latitude and declination respectively.

For lower transit the correction is positive.

Collimation.—The correction for collimation was determined from the simultaneous reduction of a set (clamp east and clamp west) of transits for time.

No direct measures were made by means of observations with collimating telescope or mercury collimator.

Azimuth.—For the determination of the deviation of the transit instrument from the meridian a polar or slow-moving star was observed in each position of the instrument in the set of time observations. The value was obtained as in the preceding case from the simultaneous reduction of the condition equations constituting a time determination. As the principal unknown sought is the clock correction, the stars comprising an observation set may be so chosen that both the collimation and azimuth corrections, irrespective of magnitude, have little effect on the deduced time.

Reduction of Observations.—As already stated a complete time determination consisted of the observation of fourteen stars, seven for position clamp east and seven for clamp west.

On a clear night two of such determinations were made. For each position there was one polar star the others being time stars. The mean of the eleven threads was taken for the time of transit. This time was corrected for level, inequality of pivots,

aberration and rate, giving thereby the corrected time of transit, but still involving the azimuth and collimation corrections besides the clock error.

The right ascensions for a given date were interpolated from the respective ephemerides, and the corrections to the R.A. of the Nautical Almanac as well as of the Berliner Jahrbuch, were applied.

Assuming then a clock correction ΔT for the mean clock time of the transits of a set, and to which time the rate was referred for obtaining the rate correction, we have for each star observed a condition equation of the form,

$$\Delta T + \delta T \quad (a - t) + Aa + Cc,$$

where $\Delta T + \delta T$ is the clock or chronometer correction. From the fourteen (or less) condition equations the three normal equations are deduced in the usual manner, and the three unknowns determined. As a rule, after beginning observing no attempt was made to level the instrument, but instead frequent readings of the level were taken. There was only one azimuth deduced for one set of clamp east and clamp west, except in a few instances, which showed displacement in azimuth after reversal. This change was due either to reversal or to the levelling done at the time of reversal. The latter reason is apparently the one for the Werry transit, and may be explained by the unsymmetrical motion of the base of the heavy levelling screw in its socket in the base plate. The change in azimuth in the few cases became only apparent, when making the final reductions. In the recomputation for such cases the normal equations were solved for two azimuths, one for each position of the instrument.

Ordinarily the exchange of clock signals took place during the interval between the two independent time determinations which each observer made nightly, provided the sky was clear. The arithmetic mean corrected for parallax of siphons of the differences of the clocks from the individual signals was taken as the difference of the clocks at the mean time of all the signals sent from or received by the respective observers, so that there was no necessity for applying a correction for differential rate. The thirty-five arbitrary signals sent by each observer were usually comprised within less than two minutes. The differential rate, however, was applied for determining the time of transmission. That is, in comparing the differences between the clocks at the mean times of the two exchanges, differential rate was applied for the interval between the mean times of the two exchanges.

We have then two clock comparisons, and they differ from each other by twice the time of transmission.

To obtain the difference of longitude, the necessary data is now available, and a simple computation from the following formula gives the difference sought.

Let t_e and ΔT_{oe} = the chronometer time and its correction at the eastern station when sending a signal.

t_w and ΔT_{ow} = similarly for the western station, when receiving the above signal.

and t'_w and $\Delta T'_{ow}$ = the chronometer time and its correction at the western station when sending a signal.

t'_e and $\Delta T'_{oe}$ = similarly for the eastern station when receiving this signal.

μ = transmission time.

$d\lambda$ = difference of longitude, west longitude being reckoned positive.

We have then from an eastern signal.

$$d\lambda - \mu = t_e + \Delta T_{oe} - (t_w + \Delta T_{ow}) = d\lambda_e$$

and from a western signal,

$$d\lambda + \mu = t'_e + \Delta T'_{oe} - (t'_w + \Delta T'_{ow}) = d\lambda_w$$

$$\text{hence } d\lambda = \tfrac{1}{2}\ (d\lambda_e + d\lambda_w)$$

This is on the supposition that the relative personal equation has been applied to the chronometer correction, and furthermore, that the time of transmission from east to west is the same as from west to east, an assumption which must be made.

Hence we obtain also $\mu = \frac{1}{2}\ (d\lambda_w - d\lambda_e)$

If we let K = relative personal equation between the two observers the following formulæ express the difference of longitude for the several links across the Pacific, the observers occupying alternate stations.

Vancouver Fanning $d\lambda^{I} = \frac{1}{2}(d\lambda^{I}_{1} + d\lambda^{I}_{2}) + K$.

Fanning Suva $d\lambda^{II} = \frac{1}{2}(d\lambda^{II}_{1} + d\lambda^{II}_{2}) - K$

Suva Norfolk $d\lambda^{III} = \frac{1}{2}(d\lambda^{III}_{1} + d\lambda^{III}_{2}) + K$.

and Norfolk Southport $d\lambda^{IV} = \frac{1}{2}(d\lambda^{IV}_{1} + d\lambda^{IV}_{2}) - K$.

hence for Vancouver-Southport $d\lambda = \frac{1}{2}(\Sigma d\lambda_{o} + \Sigma d\lambda_{e})$

That is, the difference of longitude between Vancouver and Southport, Australia, and similarly for Suva and Doubtless Bay, New Zealand, is free from personal equation even without knowing its magnitude, which, however, was determined, as stated elsewhere, for application to the Fanning and Norfolk longitudes.

The probable error of a difference of longitude was found from the probable errors of the two chronometer corrections and the probable error of the exchange of time signals.

We have then $E_{d\lambda} = \sqrt{E_{o}^{2} + E_{e}^{2} + E_{s}^{2}}$.

For the weighted mean difference of longitude of a number of nights we have $d\lambda = \left(d\lambda_{1}\frac{1}{E_{1}^{2}} + d\lambda_{2}\frac{1}{E_{2}^{2}} + d\lambda_{3}\frac{1}{E_{3}^{2}} \ldots\right)$ divided by $\left(\frac{1}{E_{1}^{2}} + \frac{1}{E_{2}^{2}} + \frac{1}{E_{3}^{2}} \ldots\right)$, the latter quantity representing the sum of the weights, which we may write $[p]$. From the weighted mean and the individual values of the difference of longitude we obtain a series of residuals v.

The probable error of the weighted mean is found from

$$E_{o}\, d\lambda = .6745 \sqrt{\frac{[p\,v\,v]}{[p]\,(n-1)}}$$

where n represents the number of individual values.

This gives then the probable error for the final difference of longitude between two successive stations.

The probable error of the longitude of a station is the square root of the sum of the squares of the probable errors of the various stations forming the chain from the prime meridian, or Greenwich, that is, $E_{l} = \sqrt{[E_{d\lambda}^{2}]}$

SYDNEY OBSERVATORY.

The following description of the instruments used at Sydney in the recent determination of the difference of longitude Sydney-Southport, has been kindly furnished by Mr. H. A. Lenehan, F.R.A.S., acting government astronomer at Sydney for New South Wales.

'The transit has a 6-inch object glass by Troughton & Simms, of London, who constructed the instrument in 1875. The focal length is 6 feet, and it is provided with a dew-cap 18 inches long.

'The bearings of the instrument are on fixed gun-metal bearings on cast-iron columns; no adjustment for corrections of level or azimuth being provided. This was designedly done, so that there would not be a possibility of alteration in any way. The eye-piece used magnifies 148 times. The instrument has two circles 2 feet in diameter, graduated to every 5 minutes of arc, and these graduations are still further

sub-divided by the micrometer microscopes, which are readily read to the tenth of a second of arc. There are two setting circles one on each side of the tube, graduated to 20 minutes of arc, and further divided by the vernier.

'Counterpoises on each pier take off the greater weight on friction wheels from the bearings, leaving very little resistance on moving in declination. A sliding reflector in the instrument regulates the illumination of the field of wires from a lamp at the end of the axis. A set of seven vertical wires and a horizontal one is provided; the equatorial intervals being about 5 seconds of time apart; and these wires are from the cocoon of one of the silk worms readily got in the gardens here. These cocoons have small sticks attached to the outer surface. We find the fibres of silk are stronger than the spider lines, and they last longer, the only drawback being their varying thickness, but this is not so marked as to cause them to be rejected.

'The instrument has a collimating telescope outside the building to the north, and reading by this (with the micrometer moving the wires) in its field, through holes in the transit circle and again through a 40-foot lens on the southern wall to a silver plate with vertical and horizontal crosses on its face. This plate is on a pier on the same level as the northern collimating telescope. We adjust the moving wires of the collimating telescope on this mark, and then take readings with the transit circle telescope on both, the mean of the adjusted wires on the northern collimator and on the southern mark gives the collimation of the transit circle, which deducting ″·010 for aberration is the final setting of the R. A. micrometer.

'Level readings are by reflection of the wires in a mercury trough on Pritchett's principle, viz., a shallow copper trough 6 inches square with an amalgamated surface containing only about ⅛ inch of mercury. This is placed in a recess below the instrument on the solid stone which carries the piers. The instrument is protected in every way from any vibrations of the building or floors, being on a separate pier extending from the bed-rock below the foundation. The observer mounted on the remover reads through a Bohnenberger eye-piece the wires covering their reflections by moving the micrometer, and the mean of these (10) readings are subtracted from the collimation, a smaller reading giving a +, a greater − sign, and expressed in the equivalent of the micrometer screw.

'Azimuth is determined by the stars by observing upper and lower transits of slow-moving circumpolar stars, and we find the instrument so extremely steady that any variation of over a fraction of a second of arc is practically not existant.

'The sidereal clock is by Frodsham, of London, and has at present a small wheel on the pendulum rod, which as it swings to the vertical presses a delicate spring into contact and marks on the chronograph for each second, omitting the 60th, thus only recording 59 beats to the minute and one break.

'A cylinder chronograph is used for observations and by diversion of current these contacts go to a tape chronograph; this is generally used with longitude. On this tape can be recorded with two pens, and can vary the beats of the clock to each pen, and the same with any signals received fro a longitude stations.

'The transit observations are recorded on the same chronograph as the clock by a flexible connecting wire and handle held by the observer, who presses a small spring with his thumb to make the necessary contacts recording the bisection of the star.

'The electricity is generated in four Edison-Lalande large cells, and the life of the battery is long.

'The seven wires observed are entered in the transit book and a mean taken for the central wire. This is corrected for the inequality of the divisions of the wires from the central wire, and then level and azimuth are applied, collimation being non existing as already explained. Then follows the usual mode for arriving at the errors of the true and observed transits. The mean of these results gives the clock error at the mean time of transits. Correction for rate is applied to each star.

'The value of the wires determined from many observations of slow-moving southern stars is here given.

Wire 1	15·156 from central wire	s.
2	10·176	- 30·486
3	5·151	
4	0·000	
5	5·247	
6	10·207	s.
7	15·407	30·861
	Difference	s. ·375
		- ·051

BRISBANE OBSERVATORY.

The services of the observatory are essentially for time purposes. The transit is by Troughton and Simms, 1883, and is mounted on a stone pillar. The objective is of 2½ inches clear aperture and 30 inches focal length. The reversing is done by hand. The reticule has seven threads, the five central threads at equatorial intervals of about six seconds. The pivots are cylindrical and there is no inequality of pivots.

On the striding level provided, fifty-six divisions are equivalent to sixty seconds of arc.

The time-piece used for the longitude work, including personal equation, was a Kullberg sidereal chronometer, provided with a one-second electric break. The chronometer had a losing rate of about three-quarters of a second per day.

The transits and exchange of clock signals were recorded on a Morse register by embossing. The register has two styles, one always recording the clock and the other, the transit key or the time signals to or from Southport, when making exchange for difference of longitude. For the clock circuit three Leclanche cells were used, and the same number for the chronograph circuit. The telegraph line connecting Brisbane with Southport is fifty miles in length.

The following are the equatorial intervals, determined by means of the micrometer, one revolution of which ·70″·s, by Mr. T. D. Fraser.

Clamp West.

	s.
1	+23·95
2	+12·46
3	+6·12
4	+0·33
5	− 5·96
6	−12·55
7	-24·35

WELLINGTON OBSERVATORY.

The observatory was established in 1869 and is used for time service only. It is situated on the summit of the hill within the old cemetery, and overlooks the city, harbour and surrounding country. The building has two rooms, a clock-room and a transit-room.

Clocks.—In the former are three mean time clocks, and one sidereal Dent No. 39720—having electrical attachment making contact or circuit every second except the 60th in order to identify the minute. The clocks are all mounted on brick and cement bases, and are fastened to substantial braced frames.

Transit.—The transit is by Troughton & Simms, and is mounted on a rather high stone pillar. It has an aperture of 2¾ inches, and a focal length of 32 inches. The reticule has seven threads at equal equatorial intervals of about 17 seconds of time. There is a sensitive striding level, and one oil lamp for illuminating the field. The single small setting circle reads to minutes and the reversing of the telescope is done directly by hand.

Meridian Mark.—The meridian mark, placed 35 years ago, which also serves for testing collimation in the day time, is a 3-inch iron bar set in cement, and shows well above the sky-line of the Tinakori range to the north.

Chronograph.—The chronograph is of the Morse pattern and records on a tape. It is provided with two styles, side by side. The one records, embossing by make-circuit, the second-beats of the sidereal clock, while the other similarly records the signals by the transit key, also the clock or arbitrary signals received (from Doubtless Bay) when making a comparison of the clocks for the determination of the difference of longitude. The transit and arbitrary signals on the tape are readily interpolated, and expressed in time, from the embossed dots or records indicating the seconds of the local sidereal clock.

Electrical Apparatus.—Mr. J. K. Logan, Superintendent of Government Telegraphs, has furnished the following description and diagram (Fig. 6) of the arrangement especially installed at the Wellington observatory, for the differential longitude work with Doubtless Bay as this was the first time that an automatic exchange of clock signals had been made with the observatory.

The Wellington clock made contact (circuit) every second, while the chronometer at Doubtless Bay was arranged to 'break' circuit.

"Two British post office polarised relays, the coils of each of which were joined in parallel, giving a resistance of 150 ohms for each relay, were connected in multiple through three Leclanche cells to the terminals of the clock. One hundred and twenty Leclanche cells, with the copper earthed were joined to one of the local terminals of one of these relays and by adjustment, the tongue of this relay was made to bear against the stop connected to that terminal. The terminal connected with the tongue was then joined to the copper terminal of a Siemens relay of 500 ohms resistance. The line was connected to the Z (zinc) terminal of the Siemens relay through a switch arranged to disconnect it from the time recording instruments and connect it to the speaking (Morse) instruments when required.

The local terminals of the Second British P.O. polar relay were connected through 8 Leclanche cells to the terminals of the magnet coils of the back style of the chronograph. The local terminals of the Siemens' relay were connected through 8 Leclanche cells to the terminals of the magnet coils of the front style of the chronograph. At every make of the clock the tongue of the P.O. relay that was connected to the back style coils, made contact and caused the style to emboss, thus registering every clock beat. The other P.O. relay at every beat of the clock broke contact at its tongue, the line current was thus broken and a signal recorded at Doubtless Bay. As this line current passed through the Siemens' relay at the observatory, and while passing held the tongue of that relay open against the bias given to it, at every break of the current the tongue by reason of that bias, moved across and closed the local circuit, thereby recording marks on the front style.

When signals were to be received from Doubtless Bay, the observatory battery of 120 cells was cut off, battery being applied at the sending end.

At every break of the current at Doubtless Bay the Siemens' relay tongue moved to close the circuit and the breaks were recorded by the front style, marks being made at the same time by the observatory clock with the other style. Arbitraries were received from Doubtless Bay in the same way.

When arbitraries were being sent from the observatory it was arranged by means of a two-way switch, to cut off the clock from one P.O. relay, i.e., the one, the tongue

of which was in the main line circuit. This relay was then worked by the closing of a key, the line current being broken at the tongue of the relay in the same way as when the clock was operating the relay. This break was recorded at Doubtless Bay and also on the front style at Wellington by the movement of the tongue of the Siemens' relay, at the same time the clock was recording on the back style.

It is desired to indicate that for received signals the tongue of the Siemens' relay had to move to close the circuit and the front style then to move to mark the tape. The signals of the observatory clock had to cause the P.O. relay tongue to move to close the circuit and the back style then to move to mark the tape. The record of the outgoing signals either from the clock or by arbitraries was got after the clock or the key had caused the P.O. polar relay tongue to break the circuit which in turn caused the Siemens' relay tongue to move to close the circuit of the front style and which style had then to move to impress the tape.

The line was 704 miles long, Wellington to Doubtless Bay, and was of 11½ copper throughout, 200 pounds to the mile."

No repeaters were used.

DESCRIPTION OF STATIONS.

Vancouver.

At Vancouver the permanent observatory built in 1909 for longitude work was occupied. It is situated on Brockton Point, immediately to the south of the lighthouse. The transit was mounted on a brick pier and a single wire connects the observatory with the city office, distant about 3 miles, of the Canadian Pacific Telegraph system. Every night at a given time, 10.30 p.m., the observatory was put in circuit with the line to Bamfield, the terminus of the Pacific Cable, for exchange of clock signals.

Fanning Island

This island or the group of three islands, of which it is one, was discovered by Captain Edmund Fanning on June 1., 1798.* At the time of its discovery it was uninhabited, although 'a stone case, filled with ashes, fragments of human bones, stone, shell and bone tools, various ornaments, spear and arrow heads of bone and stone, &c.,' were found.

The island is a coral atoll, about 10 miles long and 5 wide. It is only about 10 feet above the level of the ocean. The lagoon is surrounded by a fringe a quarter to half a mile in width on which is the plantation of cocoa-nut trees, for the production of the commercial article known as copra, owned by Greig brothers.

The cable station is at the northwest part of the island at Whaler Anchorage, and the observatory with pier was erected near the cable station. (See Fig. 7.)

Suva, Fiji.

The Fiji group, comprising several hundred islands, is too well known to require any further description. The two larger islands, Viti Levu and Vanua Levu, are both mountainous and have extinct volcanoes. The red volcanic soil of Taviuni, reminding one of the soil of the Hawaiian islands, is very fertile. The sea surrounding the group is studded with coral reefs dangerous to navigation. The vegetation on the islands is tropical and luxuriant. Commercially the principal products are sugar, copra and green fruits. Among other products may be mentioned the vanilla bean and trepang or bêche de mer, the latter for the Chinese market. The natives at one time the most ferocious cannibals are now docile under British rule. Bounteous nature makes them indolent, since their vocation—fighting—is gone.

Two factors militate against the development of Fiji—one is, want of labour, and the other, the difficulty of acquisition of land,—all the land, save a small part, being

* 'Voyages Round the World' by Edmund Fanning: London, O., Rich., 1834

still held by the natives and in common, so that there is great difficulty in securing land for cultivation. Suva, on Viti Levu, is the official capital, and the residence of the governor of the South Sea Islands. No military is stationed here, but a native constabulary is maintained.

The observatory (Fig. 8) was built on the Pacific Cable premises (Figs. 9 and 10). The material used in construction was planed, tongued and grooved flooring throughout. The building is ten feet square, gable roofed, and has a three-inch opening around the eaves for circulation of air. This arrangement worked very well and prevented the instrument during the day-time becoming unduly heated. There were two shutters on each side of the roof, giving a clear opening of two feet.

The pier was built of concrete. A cubic yard of concrete was sunk in the earth and the pier proper, 22 inches by 27 inches, built to a height of 30 inches above the floor of the observatory. It was learned afterwards that the ground upon which the pier was built had been filled in something over a year before to a greater depth than the excavation for the pier. This may in a measure account for the movement of the pier, although part of this motion is undoubtedly attributable to the tides. That is, the daily loading (twice) of the ocean bottom near the shore by high tide would have the tendency to tilt the pier towards the sea, which effect would later be counteracted when low tide had set in. The pier is situated 17 feet west from the cable building (verandah), 42 feet north from the south limit of the cable lot, and 11 feet from the edge of the sea at high tide.

For the pendulum observations another similar pier but only 2 feet above the floor was built within a adjoining hut, 7 feet square, to the east. The south walls of the observatory and pendulum huts were in straight line. The floors of the two buildings were 5 feet 8 inches above high tide, so that the pendulum bob was, say, 8 feet above high tide.

The tides at Suva harbour average between 3½ to 5 feet.

For the magnetic station it was not so easy to find ideal ground. The ground had to be within reasonable distance from the observatory, to carry the instrument and chronometer to and fro.

Corrugated iron has become a most important element in building operations of the most diverse kinds in the tropics. It is used for roofs, for fences, in place of weather beards, and for many other purposes. Especially in Australia does corrugated iron meet the eye at every turn.

After examining the vacant grounds in Suva, the embryo park to the south of the cable premises was chosen for a site for the magnetic station.

The local surveyor, Mr. G. Heimbrod, who laid down a meridian for erecting the pier and observatory, also made the connection between the astronomic and magnetic stations and gave the true azimuth of some reference points from the latter. The Honourable Geo. Moore, Commissioner of Public Works, kindly placed a tent at my disposal for shelter to the instruments while observing at the magnetic station.

Norfolk Island.

Historically this isolated island (about 9,000 acres) is best remembered as a British penal colony, and later (1856) as the new home of the Pitcairn islanders, the descendants of the mutineers (1789) of the ship *Bounty*, Captain Bligh. In former days the island was the chief centre of the large whale fishing industry of the South seas. This industry has, however, much declined. The best known product of the island is the Norfolk island pine (Araucaria excelsa). An avenue of these trees is a superb sight, but in the individual tree the branches are rather too far apart to give it a finished symmetry and beauty.

The cable lands at Anson bay at the northwestern point of the island, and the cable buildings are in close proximity to the precipitous cliffs of the shore. The observatory with pier was erected between the cable building and connected in dis-

tance and azimuth to a stone monument as shown on the accompanying diagram (Fig. 11).

Southport.

The observatory built here was erected 30 feet southerly from the brick pillar supporting the water tank near the south entrance to the offices of the cable building. The magnetic station was in the vacant field of the cable premises and 186 feet southward from the astronomic station (Fig. 12). The observatory was 10 feet square and built similar to the one at Suva already described. For foundation of the pier a cube of grouting was built in the earth, leaving its sides free from firm contact with the earth. The pier 22 inches by 27 inches itself was built of brick with an inch cap of concrete.

The alignment for the pier and observatory was obtained without the aid of instruments by low north and south stars and a plummet, sidereal time having been deduced from the noon mean time signal from the observatory at Brisbane.

At this station, connection was made with the observatories at Brisbane and Sydney; and for this purpose, the land line in the cable office was led to the observatory so that the clock and arbitrary signals during the nightly exchange with those observatories could be recorded on the chronograph.

The route line distance to Brisbane was 50 miles, and to Sydney, 773 miles. The conductor was of copper, weighing 200 lbs. to the mile. The line was cut through to Sydney direct during the exchange, that is, no relay was interposed between the terminal stations.

Doubtless Bay, N.Z.

At the foot of the deep bay of the above name the cable from Norfolk island lands on a sandy beach. Close to the cable station the pier and observatory were built (Fig. 13). The foundation of the brick pier was in compact sand, and hence very satisfactory. The building and pier were of the same dimensions as those of Southport and Suva.

A triangulation has been carried over the North Island by the Survey Department of New Zealand. By instruction of the Surveyor General, Mr. J. W. A. Marchant, the district surveyor, Mr. V. J. Blake, made a connection of the triangulation system with the observatory, pendulum pier and magnetic station, as shown on the accompanying sketch (Fig. 14).

The country about the station is open and hilly. Much of the ground is covered with ti-tree scrub, and in the valleys the tree fern, cabbage tree and the kauri pine are found. Near the sea-coast on rocky exposures scattered pohutukawas, or Christmas trees, with their beautiful, large, red flowers and glossy leaves are seen. The English name of the tree was given because it flowers at that season.

The rocks observed were strongly impregnated with iron.

AUSTRALIAN LONGITUDES.

Former Values.

Australia.

The transit of Venus in 1874 gave an impetus to the determination of longitudes. Some of these longitudes were determined by means of the telegraphic submarine cables, while others were dependent upon absolute methods,—moon culminations and occultations.

To the latter belonged Sydney. Consequent to the German Venus expedition to the Auckland islands, Dr. A. Auwers recomputed the voluminous data (mostly from Mr. Tebbutt and Mr. Russell) on hand for the longitude of Sydney, through which he laid the fundamental meridian for Australia.

This gives the longitude of Sydney as $10^{h.}\ 04^{m.}\ 49^{s}\cdot60$.*

* Astron. Nach. No 2036

In the joint report † of the government astronomers, Ellery, Todd and Russell we read: 'Some time prior to the transit of Venus, in December, 1882, we severally received communications from the President of the Royal Society, London, relative to the telegraphic determination of the longitude of Australian observatories, which involved, as a first step, the telegraphic determination of the difference of longitude between Port Darwin and Singapore . . . . . , Singapore being the initial point of these determinations, the actual longitude of Port Darwin and hence all Australian longitudes would depend on the accuracy of the assumed longitude of Singapore, which has twice been telegraphically determined first, in 1871, by Dr. Oudemans, of Batavia, and Mr. Pogson, of Madras, and more recently, in 1882, by Commander Green, United States Hydrographic Department. For reasons given in the appendix, we agreed, after full consideration, to accept Commander Green's position of Flagstaff at Fort Canning, viz., $6^{h.}\ 55^{m.}\ 23^{s}\cdot 50$. Reducing this to Captain Darwin's observing station + $1^{s}\cdot 51$, makes the longitude of Captain Darwin's transit instrument $6^{h.}\ 55^{m.}\ 25^{s}\cdot 01$. The difference of longitude, Port Darwin-Singapore, determined by Captain Darwin and Mr. Baracchi, is $1^{h.}\ 47^{m.}\ 57^{s}\cdot 48$, making the longitude of Port Darwin $8^{h.}\ 43^{m.}\ 22^{s}\cdot 49$ E. of Greenwich.'

The station at Port Darwin was marked by a masonry pillar 4 x 2 x 2 feet, upon which the transit stood, and is the origin of Australian longitudes.

By means of the telegraph lines Port Darwin, Adelaide, Melbourne and Sydney were connected in longitude, and similarly by cable Melbourne with Hobart, and Sydney with Wellington, New Zealand. It must be remembered that up to this time in most cases, when the cable was used for the exchange and comparison of clock signals, the small deflecting mirror, throwing a beam of light on a scale, indicated the arrival of the signal impulse. This visual manifestation had then to be recorded in time, either by the 'eye and ear' method or by tapping a key in circuit with a chronometer and chronograph. Comparison of chronometers over a cable by this means has not nor cannot have that accuracy obtained in more recent times by the exclusive use of the Thomson (Lord Kelvin) siphon recorder, to be described later. In the Bombay-Aden-Suez, 1877 longitude, the siphon was used.

In order to estimate the value of Australian longitudes it is necessary to examine the assumed position of Singapore upon which those longitudes rest.

Mr. P. Baracchi, who was the observer at Port Darwin, and is now Government Astronomer, at Melbourne, for Victoria, presented a paper on 'The most Probable Value and Error of Australian Longitudes' to the Australasian Association for the Advancement of Science, at the meeting in Brisbane in 1895.

Mr. Baracchi has expended much labour in compiling from so many sources the required data, and has put the results in such compact form, that I avail myself in reproducing the greater part of it here. He always gives the 'mean error' instead of the 'probable error' as is customary in our work. The former is readily converted to the latter by simply multiplying it by ·675.

He writes:—I shall therefore commence at the beginning, viz., the prime meridian. The values of intervals, as given in Appendix, Table 1, will be referred to by the letters respectively attached to them.

Longitude of Alexandria—Six different values—viz., (*a*), (*b*), (*c*), (*d*), (*e*) and $\frac{1}{2}$ ($f+f_{,}$)—may be combined, giving three values for this longitude, two of which are quite independent.

(*a*) Greenwich-Mokattam.—This was determined by exchange of galvanic signals between Greenwich and Porthcurno; Porthcurno and Alexandria (by joining the five lengths of cable, Porthcurno, Vigo, Lisbon, Gibralter, Malta, Alexandria); and finally, between Alexandria and Mokattam. Time observations were made with transit instruments at Greenwich, Alexandria, and Mokattam, but those at Alexandria were not used for this interval. The observers were Mr. Criswick at Greenwich, Mr. Ellis-

† Report of the Telegraphic Determination of Australian Longitudes—Melbourne, 1886.

at Portheurno, Mr. S. Hunter at Alexandria, and Capt. C. Orde Brown, R.A., at Mokattam. Trans'ts were recorded by eye and ear at these two latter places. All galvanic signals were sent by hand, and observed by eye and ear. The operations were executed in November, 1874, on the four nights, 14th, 15th, 21st and 22nd. The personal equation in observing transits between Mr. Criswick and Capt. Brown was determined before and after the longitude operations, and varied from 0·025 sec. to 0·655 sec.—(8) page 288.

(*b*) *Alexandria-Mokattam.*—(8) On the same four nights, November 14, 15, 21 and 22, Mr. Hunter, at Alexandria, made transit observations with a portable transit instrument, in addition to exchange of signals with Mokattam. His station, which was on the roof of the Hotel de l'Europe, does not seem to have offered the necessary stability for delicate work. Dr. Gill remarks of this station—(7) page 63—'The observer had to abstain from movement during each complete observation, otherwise the level was disturbed by the change of his position.' The personal equation of the two observers was determined after their return to England. At Alexandria the chronometer had to be carried to the telegraph office for exchange of signals, which was at a distance of about five minutes' walk.

(*c*) *Greenwich-Berlin.*—Result of several determinations—(9) page 490.

(*d*) *Berlin-Malta.*—Observers: At Malta, Dr. Löw, chief of the German expedition of the Transit of Venus, 1874, to Mauritius; at Berlin, the astronomers of the observatory, Drs. Becker, Auwers and Knorre. Dr. Löw made three observations with a portable transit instrument, recording by the eye and ear. Galvanic signals exchanged by hand on six nights in 1875, March 10, 11, 12, 13, 14 and 17. Personal equation well determined. Signals satisfactory—(9) page 360-393.

(*e*) *Malta-Alexandria.*—Observers: Dr. Löw at Malta, Dr. Gill at Alexandria, same station as Mr. Hunter's. Dr. Gill made his time determinations with an alt-azimuth. Operations repeated on the nights of March 10, 11, 12, 13 and 14 (1875). Personal equation of these observers well determined.

The chronometers had to be carried to the telegraph station for exchange of signals, as in the case of (*b*)—(9) page 306-320.

(*f*) *Berlin-Alexandria.*—Direct measurement made on February 28, March 6, 7, 10, 12, 13 and 14 (1875). Personal equations of the observers, known through Dr. Löw; the observers being Dr. Gill at Alexandria, and the astronomers of the observatory at Berlin. This value was deduced by Dr. Copeland. It is remarked in (9) that the signals were unsatisfactory, and the combination of the two intervals (*d*) and (*e*) was adopted in preference of the direct value—(9) page 320-348.

(f_1) *Berlin-Alexandria.*—Same operations as in (*f*). Value deduced by Dr Auwers—(7) page 60.

The three values for the longitude of Alexandria are:

	h.	m.	sec.
By the combination (*a*)-(*b*)	1	59	33·69
(*c*)+(*d*)+(*e*) . . .	1	59	33·827
(*c*)+½ [(*f*)+(f_1)]	1	59	33·750

The following values were adopted, viz.:—

(9) Page 491—

By Dr. Copeland.... $1^{h.}\ 59^{m.}\ 33^{s}\cdot807$

(7) Page 60—

By Dr. Auwers.. .. $1^{h.}\ 59^{m.}\ 33^{s}\cdot885$

Mean error.

mean $1^{h.}\ 59^{m.}\ 33^{s}\cdot846 \pm 0^{s}\cdot078$ I.

(8) Page 330—

By British Transit of Venus Expedition. $1^{h.}\ 59^{m.}\ 33^{s}\cdot69 \pm 0^{s}\cdot156$ II.

The values I. and II. of the longitude of Alexandria are independent. Their difference is 0·156 seconds.

(*g*) *Alexandria-Suez.*—Observers: Dr. Löw at Suez, Dr. Gill at Alexandria. Instruments for time determination, same as already stated above. Galvanic signals

exchanged on five nights, viz., 1875, February 19, 20, 23, 24 and 25. Signals sent by hand; observations made by eye and ear. At both stations the chronometers had to be carried for some distance to exchange signals. Result computed by Dr. Copeland (9) page 492.

(g_1) *Alexandria-Suez.*—Same operations as in (g). Result deduced by Dr. Auwers—(7) page 60.

(h) *Mokattam-Suez.*—Observers: Mr. Hunter at Suez, Captain Brown at Mokattam. The instruments used by these observers have already been referred to in (a) and (b). The signals were sent by hand, and the observations made by eye and ear. Operations repeated on four night, viz., 1874, December 4, 5, 7 and 14. The station used by Mr. Hunter was not the same as Dr. Löw's station. The former appears to have given trouble on account of its instability. It is remarked by Mr. Hunter (8) page 333 'The only defect arose from the looseness of the soil, causing the level readings to vary a good deal.' The same complaint is also made by the officers of the Great Trigonometrical Survey of India, who used this station in 1877, viz., that their observations may be somewhat vitiated by the unsteadiness of their instruments, due to looseness of the soil—(12) page 45a.

(i) Difference of longitude between Dr. Löw's and Mr. Hunter's stations at Suez.

This was determined by Dr. Gill by time observations made by himself with Dr. Löw's transit instrument mounted at one station, and with his altazimuth mounted at the other station, and by transportation of nine chronometers to and fro. The value thus found was 0·32 seconds—(9) page 262-266.

(i_1) The same interval as (i), determined by a traverse under the direction of Captain (now Colonel) Campbell, R.E.; its value was found to be 0·025 seconds (9) page 491 and (11) Appendix to Part II., page 109. The discordance between the two above values is 0·295 seconds. This may be probably accounted for, or at least partly, by the length and complex character of Dr. Gill's operations, when compared with a simple traverse; and also by the circumstance remarked in (9) page 262, that 'these operations required seven and a-half hours of continuous observing, involving great fatigue.'

We have thus the two following independent values for the interval Alexandria-Suez, reduced to Hunter's station, by adopting value (i_1), viz.:

	h.	m.	sec	sec.
$\frac{1}{2}\{(g)+(g_1)\}+i_1$	0	10	39·025	± 0·082
$(b)+(h)$	0	10	39·481	± 0·160

which differ by 0·456$^{sec.}$

The value for Alexandria-Suez, deduced from the two above, weighted in terms of their respective mean error, is

	h.	m.	sec.	sec.
Interval Alexandria-Suez.	0	10	39·120	± 0·073. . .III.

(k) *Suez-Aden.*—Observers: Dr. Löw at Suez, Dr. Gill at Aden. Time observations at Aden were made with some difficulty; in fact, 'opportunities for observing were few and unsatisfactory'—(9) page 5. At Aden, the distance between the observing station and the telegraph office where signals were sent and received was nearly two miles. The operations were very limited, and the result depends on time observations of the single night of January 31, and on the exchange of galvanic signals on the two nights of January 30 and 31. This result was computed by Dr. Copeland (9) pages 196-227.

(k_1) *Suez-Aden.*—Same operations as in (k). Result given by Dr. Auwers—(7) page 61.

(k_2) *Suez-Aden.*—Observers: Captain (now Colonel) Campbell, R.E., at Suez; Captain (now Colonel) Heaviside, R.E., at Aden. Station at Suez the same as Mr. Hunter's. Station at Aden, a few yards north of the cable offices at Telegraph Bay.

These officers aimed at the highest refinement possible, and had at their disposal the necessary equipment and conveniences wherewith to attain their purpose—(11), Part I., Chapter I. Their transit instruments were of similar dimensions and workmanship (5" object glass, with collimators, and means of levelling by mercury reflection, &c.). They recorded observations by chronograph. Galvanic signals were always exchanged directly between the stations, being sent by hand, and simultaneously recorded on both chronographs. Their operations were repeated on the six nights of 1877, May 25, 26, 27, 28, 29, and 30, giving very accordant results. Their personal equation was determined on four nights in April, 1877; and although it was not redetermined after the expedition, no serious consequences may be feared on that account. The observers themselves are confident that it remained fairly constant—(11), Part I., page 34. On the other hand, if their usual mode of observing was liable to sudden changes of considerable magnitude (of which there is no evidence), a redetermination after the expedition would have given very little help in finding the actual changes that took place at Suez and Aden. The only disadvantage in this measurement is to be attributed to the unsteadiness of the station at Suez, as already pointed out in (*h*)—(11), Part II.

(*l*) Difference of longitude between Dr. Gill's and Captain Heaviside's station at Aden.

This was determined by a careful triangulation, made under the direction of Captain Heaviside—(11) App., Part II.

We have, then, for the interval Suez-Aden reduced to Mr. Hunter's station at Suez, and Captain Heaviside's at Aden:

	h.	m.	sec.	sec.
$\frac{1}{2}\{(k)+(k_1)\}-i_1-l$	0	49	42·839	± 0·120
(k_{11})	0	49	42·662	± 0·060

The difference between these two independent results is 0·177 sec. Combining them according to their mean errors, we have—

	h.	m.	sec.	sec.	
Suez-Aden	0	49	42·697	± 0·054	. . . . . IV.

The longitude of Aden, reduced to Captain Heaviside's longitude station, may now be derived by combining the several values shown in the foregoing, in the manner adopted by Dr. Gill—(7) pp. 60-62—omitting the value given for Alexandria-Mokattam, viz.:—

By the British Transit of Venus Expedition of 1874, and the officers of the G. T. S. of India.

	h.	m.	sec.	sec.
(*a*)	2	05	06·240	± 0·098
(*h*) . .	0	05	06·931	± 0·103
(k_{11})	0	49	42·662	± 0·060
A	2	59	55·833	± 0·154

By Lord Lindsay's Expedition of 1874, and Dr. Löw.

I	1	59	33·846	± 0·078
$\frac{1}{2}\{(a)+(a_1)\}$	0	10	39·000	± 0·082
$\frac{1}{2}\{(k)+(k_1)\}$	0	49	43·742	± 0·120
(*l*)	−0	00	00·877	± 0·
B	2	59	55·711	± 0·165
A	2	59	55·833	± 0·154
B	2	59	55·711	± 0·165
Longitude of Aden (Capt. Heaviside's sta.)	2	59	55·776	± 0·113

Dr. Gill considered the mean errors of the two values A and B as equal, and adopted for the definitive longitude of Aden ½ (A + B) (7) p. 62, viz.:

Aden E. of Greenwich $2^{h.}\ 59^{m.}\ 55^{s.}\cdot772 \pm 0\cdot070^{sec.}$ (should be $0\cdot076^{sec.}$?)

(*m*) *Aden-Bombay.*—**Observer: Dr. Gill at Aden (Gill's station).** The operations at Bombay were conducted under the direction of Mr. C. Chambers, Superintendent of the Colaba Observatory. Time at Bombay was determined by a transit instrument 5 feet focal length. Records made by chronograph. Time signals sent by hand, and observed by eye and ear at both stations. These operations took place in 1875, on 31st January, concurrently with the determination Suez-Aden by Drs. Gill and Löw; the time observations of this single night being all that could be secured at Aden. The personal equation between the observers not determined (9) pages 182-195.

(m_1) *Aden-Bombay.*—**Observers: Captain Campbell at Aden, and Captain Heaviside at Bombay.** This measurement was made with the same instruments and methods described in (k_1). The station at Aden was the same as that occupied by Captain Heaviside in determining the interval (k_1). That at Bombay was $0\cdot131^{sec.}$ east of the Colaba Observatory transit instrument. The operations were repeated on nine nights in 1877 April 30, May 1, 2, 3, 4, 5, 7, 8, and 9 giving accordant results.

The two values (*m*) and (m_1) are quite independent. The former is based on observations and conditions not altogether satisfactory (as we have seen), with very limited time and great disadvantages, and involving the unknown element of the personal equation of the observers. The latter value (m_1) is the result of elaborate operations extending over a period of nine nights, and made under the best possible conditions; yet these two results differ only by $0\cdot03^{sec.}$

(*n*) *Bombay.*—**Difference of longitude between Captain Heaviside's station and the transit instrument of the Colaba Observatory.** This was determined by a traverse measured under the direction of Captain Heaviside (11).

(*o*) *Bombay-Madras.*—**Observers: Captains Campbell and Heaviside.** Station at Bombay the same as that used for the interval (m_1). That at Madras was 65 feet due north of the transit circle of the Madras Government Observatory. This interval, though not determined directly, is certainly as well ascertained as any other— (11), Part I.

Its value is deduced from the telegraphic measurement of the difference of longitude of nine Indian arcs joining the six stations—Bombay, Bolarum, Bellary, Mangalore, Vizagapatam, Madras; the most direct route being Bombay-Bellary-Madras. (See diagram in (11) Part I., page 16.) The operations were executed by these officers in 1875-76-77 through the land lines, using the same instruments as mentioned in (k_{11}). Time signals were exchanged automatically, and simultaneously recorded at the two stations. Every possible precaution was taken to guard against error, systematic or accidental, and the work generally was carried out with a completeness that leaves nothing to be desired. The result for this interval is shown in (11) Preface to, Part I., page (xviii.).

We are now enabled to deduce the longitude of Madras; but before doing so, I shall mention and consider another set of totally independent operations, which must be regarded as a powerful check upon all others hitherto discussed—viz., the determination of the longitude of Madras, via Ispahan-Kurrachee. Indeed, if it were not for the very limited and somewhat incomplete observations at Kurrachee, and the undetermined personal equation of the observers at Ispahan and Madras, this chain would be entitled to much greater weight than the one via Suez-Aden-Bombay, because it connects Madras with Greenwich in four steps including only five stations, three of which are fixed national observatories, in addition to having the interval Kurrachee-Madras measured twice independently. I regret that, with the exception of the operations at Madras and Kurrachee, the details of the observations are not at hand; the

results given here being taken from General Addison's paper (10) page 83, and (13) pages 47, 54, 81. The actually measured intervals are as follows:

(*p*) *Berlin-Ispahan.* Observers: The astronomers of the Berlin Observatory, at Berlin; and Dr. Fritsch, chief of German Transit of Venus Expedition in Persia (1874), at Ispahan. The operations were repeated on eight nights—viz., November 16, 17, 18, 19, 20, 21, 23 and 27.

(*q*) *Ispahan-Kurrachee.* Observers: Dr. Fritsch at Ispahan, and General T. Addison, C.B., at Kurrachee. General Addison observed for time with a portable transit instrument, and recorded his observations as well as galvanic signals by chronograph. Signals were exchanged on December 11 and 12, 1874. Personal equation between the observers not determined—(10) page 83.

(*r*) *Kurrachee-Madras.*—General Addison at Kurrachee, and Mr. Norman Pogson, Government Astronomer, at Madras. Galvanic signals were exchanged on one night only—viz., December 13. The time at Kurrachee depends on the observation of three stars. Results given by General Addison—(10) page 83.

(r_1) *Kurrachee-Madras.*—Same operations as in (*r*); values deduced by Mr. Pogson—(13) pages 47, 54, 81.

(r_{11}) *Kurrachee-Madras.*—This interval was determined indirectly through Bombay and Bellary and other Indian arcs by Captains Campbell and Heaviside in their usual excellent manner, as already spoken of. The operations were executed in 1880-81.

(*s*) Difference of longitude between General Addison's and Captain Campbell's station. The position of the former was $0{\cdot}6^{sec}$ east of the station 'used in the Great Trigonometrical Survey at that place'—(10) page 84. The position of the latter is described in (11) Part I., page 252, as being 61 feet north, and 152 feet = 4″·65 $0{\cdot}11^{sec}$ west of the 'Telegraph Office Station,' which is a point 'on the eastern terrace of the upper story of the block of dwelling quarters standing in the angle between Macleod road and Telegraph road, marked by a circle and dot engraved on the floor of the terrace, and connected with the Hill Stations A and Mutrani of the G. T. S.' It seems, therefore, that the 'Telegraph Office Station' is the one referred to by General Addison as being $0{\cdot}6^{sec}$ west of his observatory.

We may now compare the three values (*r*), (r_1), (r_{11}) of the interval Kurrachee-Madras, reducing them all to the Telegraph Office Station of the Great Trigonometrical Survey.

	sec.	h.	m.	sec.
(*r*)	+ 0·60 =	0	53	06·82
(r_1)	+ 0·60 =	0	53	06·45
(r_{11})	− 0·11 =	0	52	55·61

The two values (*r*) and (r_1) are derived from the same few and simple observations of a single night. Their difference is $0{\cdot}37^{sec}$ and has not been accounted for by the astronomers concerned. The value (r_{11}) is $11{\cdot}21^{sec}$ smaller than (*r*), and $10{\cdot}84^{sec}$ smaller than (r_1). This large error was pointed out in (6), page 31. No doubt some clerical mistake occurred somewhere, or the position of General Addison's station may be misunderstood; but to assume that this is a clerical error of ten seconds so as to make it a round number, as Mr. Pogson proposes—(13) page 81—seems arbitrary. It is strange that in all these years we have never heard an explanation of this matter.

The longitude of Madras is thus arrived at by two routes, as follows:

Via Suez-Aden-Bombay.

	h	m.	sec.	sec.
Longitude of Aden (Gill)	2	59	55·772	± 0·113
Aden-Bombay (m_1)	1	51	19·973	± 0·056
Bombay-Madras (*a*)	0	29	43·530	± 0·058
Longitude at Madras, VI.	5	20	59·275	± 0·139

Via Ispahan-Kurrachee.

	h.	m	sec
(*e*)	0	53	34·865
(*p*)	2	33	05·44
(*q*)	1	01	13·09
½ {(*e*) + (*q*)}	0	53	06·035
Longitude of Madras	5	20	59·430 ... VII.

It would appear from result VII. that the error at Kurrachee vanishes in the case of the two intervals Ispahan-Kurrachee and Madras-Kurrachee; in which case the results VI. and VII. compare very well indeed, considering that the unknown personal equation (Fritsch-Pogson) is involved in VII. I think, however, that this latter value may not be used for any further purposes at present. It would be difficult to do proper justice to it, even if favourable assumptions were made, which is always a dangerous course.

(*l*) *Madras-Singapore.*—Observers: Dr. J. A. C. Oudemans, Surveyor-General of Java, at Singapore; Mr. Pogson, at Madras. This measurement was made in July, 1871, by the exchange of galvanic signals, through the cable, on the evenings of 24th, 25th, 26th and 28th. Mr. Pogson observed with the transit circle of the observatory and clock, but had to carry a mean time chronometer to the cable offices for exchange of signals at a distance of four miles. Dr. Oudemans made his time determinations on the 24th by observing zenith distances of two stars with a universal instrument. On the 25th and following dates the observations were made with a 'broken transit instrument' viz., one of the form in which the eyepiece is at one end of the horizontal axis. He also had to carry his chronometer to the cable offices for exchange of signals at a distance of three-quarters of a mile. Observations at both stations were made by eye and ear, no chronographs being used. The personal equation of the observers was not determined (13) page 11, and (15) page 69. The point to which Dr. Oudemans referred his longitude was the position of the flagstaff on Fort Canning in 1871 see (15) page 69, and (14) page 211.

This result was deduced by Dr. Oudemans (14) page 214.

(*l*) *Madras-Singapore.*—Same operations as in (*l*). Result given by Mr. Pogson (13) pages 11-24

(*l*) *Madras-Singapore.* This determination was made by Lieut. Commander C. M. Davis, U.S.N., at Madras, and Lieut. John A. Norris, U.S.N., at Singapore, in 1882; the operations being repeated on the five nights of January 20, 21, 23, 26, and 27. These officers made their time observations with the so-called 'broken transit instruments,' which offer the great advantage that the observer remains in the same position during observations of stars at all altitudes—a condition greatly favouring the constancy of personal equation. They exchanged galvanic signals directly from their huts, thus avoiding the danger of having their chronometer rates accidentally disturbed, and errors of comparison. They had chronographs upon which their observations were recorded, and their personal equation was continuously tested by 'absolute personal equation instruments,' each observer being provided with one. This equation, however, was not introduced in the results, on account of its being always very small, and probably no greater than its possible variations. Cable signals were observed by reflecting galvanometers. The observers were especially well trained for that class of work, having made together many longitude determinations in various parts of the world. Their plans were all prearranged and methodically carried out,

and the excellence of their results is shown in the agreement of values deduced from each night's observations. The discrepancy between the values (t) and (t_1) is 0·71 seconds, and that between (t_1) and (t_2) is 0·51 seconds. The Australian astronomers, in their report (6) page 31, adopted the value (t_1), which course, considering the circumstances surrounding the two determinations of this interval, was no doubt the best.

(*w*) *Singapore to Port Darwin.* This interval was determined in 1883, the observers being Captain (now Major) L. Darwin, R.E., at Singapore, and myself at Port Darwin. Captain Darwin made his time observations with the transit instrument previously used by the British Expedition of the Transit of Venus in New Zealand in 1882, and I observed with an excellent portable transit instrument (3½ inches object glass). The observations were recorded by chronograph. Galvanic signals were exchanged directly between the stations, sent by hand, and observed by reflecting galvanometer at each receiving observatory. Our personal equation was determined before the undertaking at Melbourne, and experiments were made at Melbourne and Sydney to test our mode of observing and transmitting signals. Three different methods were used in exchanging signals, in accordance with the plan proposed by Captain Darwin, which was strictly adhered to throughout. This plan is described in (6) page 26. The operations were repeated on the nights of February 13, 14, 15, 22, 23, 25, and 26.

The two cable lengths Singapore-Banjoewangie and Banjoewangie to Port Darwin were joined; and the signals, though passing through a distance of over 2,000 miles, were satisfactory when the circuit was good. On some occasions they appeared unsteady; but the greater attention then required in observing them seemed to compensate for their inferior quality, as the individual results show.

(*x*) Difference of longitude between the flagstaff on Fort Canning (position of 1871) and Lieut. Norris' station at Singapore in 1882. This latter is the same as that occupied by Captain L. Darwin in 1883. This value is given in (15) page 68, and was determined by measurement by Lieut. Norris. The flagstaff was west of Lieut. Norris' station. My station at Port Darwin was on the ground of the Eastern Extension Telegraph Company, 56 feet N. 10·22 E. of the veranda post at the northeast corner of the cable officer's quarters. It was marked by a masonry pillar 4 x 2 x 2 feet, upon which the transit instrument stood. This point is now the origin of the Australian longitudes (6).

(*w*) *Singapore-Banjoewangie.* Observers: Captain Darwin at Singapore, and Captain H. Helb of the general staff, Batavia at Banjoewangie. Captain Helb made his time determinations by observing zenith distances with a portable universal instrument. Galvanic signals were exchanged on February 17, 18, 19, 21, and 23, 1883. The personal equation between the observers was not determined (6) page 29.

(*w*) *Banjoewangie to Port Darwin.* This interval was determined by Captain Helb and myself. Signals were exchanged on four nights, viz., January 28, February 1, 22, and 23, 1883. Personal equation between the observers not known.

These operations were arranged at the request of the Dutch Government in order to verify the longitudes of Batavia. We were glad to have Captain Helb's co-operation, as it was not certain whether the direct signals between Singapore and Australia would be good enough for the purpose, and also as a check to our work. Captain Helb shortly after sent all his observations in detail over to Melbourne, where they were found in every respect excellent.

The two values (w) and (w_1) offer a partly independent value of the interval Port Darwin to Singapore, although the Banjoewangie longitude itself remains affected by the unknown personal equation of H. D. and B. The difference between the direct value (w) and the indirect one (w) + (w_1) is as follows, viz.:

	h.	m.	sec.	sec.
(w)	0	42	06·78	± 0·076
(w_1)	1	05	50·84	± 0·091
	1	47	57·62	
Personal equation (D.B.)			·02	

	h.	m.	sec.	sec.	
Singapore to Port Darwin (indirect)	1	47	57·60	± 0·119	Difference
Singapore to Port Darwin (direct) (u)	1	47	57·48	± 0·046	0·12sec.

These combined in terms of their mean errors give:—

Singapore (Captain Darwin's station)—

	h.	m.	sec.	sec.	
Port Darwin	1	47	57·49	± 0·045	VIII.

The longitude of Port Darwin may now be deduced, viz.:

	h.	m.	sec.	sec.
Longitude of Madras (VI.)	5	20	59·275	± 0·139
Madras to Singapore (t_n)	1	34	24·07	± 0·010
(v)			1·51	±
Singapore to Port Darwin (VIII.)	1	47	57·49	± 0·045
Longitude of Port Darwin (IX.)	8	43	22·34	± 0·152

(x) *Port Darwin to Adelaide.*—Observers: Mr. (now Sir Charles) Todd at Adelaide, and myself at Port Darwin. The observations at Adelaide were made with the transit instrument of the observatory. The exchange of galvanic signals here consisted in sending clock-beats to each other automatically (generally two sets of two minutes each), which were simultaneously recorded on the chronographs at the two stations, the chronograph of the receiving station recording at the same time the beats of its own clock. The personal equation between the observers was determined on several occasions through Mr. E. J. White, then Chief Assistant at the Melbourne Observatory, and directly in Melbourne. The operations were repeated on six nights viz., February 14, 15, 22, 23, and 26, and March 2, 1883—(6) page 22.

(y) *Melbourne-Adelaide.*—The operations for this interval were carried out at the two observatories under the direction of their respective government astronomers, Mr. Ellery and Mr. Todd. The observations were made by the latter at Adelaide, and by Mr. E. J. White at Melbourne. Clock-beats (generally two sets of two minutes each) were exchanged, and simultaneously recorded on the chronograph of both stations, &c., as in the case of the interval (x), Port Darwin to Adelaide. Personal equation between Messrs. Todd and White was determined several times. Comparisons made on five nights—viz., February 15, 17, 23, 26, and March 2 (1883).

(x_1) *Port Darwin to Melbourne.*—Observers: Mr. E. J. White at Melbourne, and myself at Port Darwin. The operations were exactly similar to those described in the two preceding intervals. Time signals were exchanged on four nights—viz., February 15, 23, 26, and March 2 (1883), the individual results being very fairly accordant. The personal equation between the observers was determined before and after the expedition—(6) page 22.

The value (x_1) ought to be equivalent to the sum of (x) and (y).

We have, in fact

	h.	m.	sec.	sec.
Adelaide to Port Darwin (x)	0	30	57·80	± 0·041
Melbourne to Adelaide (y)	0	25	33·84	± 0·050
Melbourne to Port Darwin, indirect	0	56	31·64	
Melbourne to Port Darwin (x_1), direct	0	56	31·66	± 0·041

(z) *Sydney-Melbourne.* This interval was measured five times by direct connection of the observatories between the years 1861 and 1884. The operations consisted, as usual, in the automatic exchange of clock-beats, producing chronographic records at the two observatories, and in time determinations made with the transit circles of these institutions, the whole under the direction of the respective government astronomers. An indirect determination was made in 1868 through the longitude station at the western boundary of Victoria, of which more hereafter.

The last indirect measurement took place in 1887, through Mr. John Tebbutt, private observatory at Windsor, New South Wales. Mr. Tebbutt made his time determinations with a small transit instrument; sent his signals by hand from the local telegraph office, which is at a distance of (?) miles from his observatory, using a mean time chronometer, and observing the incoming signals by coincidence of beat. His operations were conducted with great care, and gave very satisfactory results.

The astronomers at Melbourne give great weight to the value of 1861, and to those of May and August, 1884. The mean of the five independent values is $24^{m.}\ 55{\cdot}40^{sec.}$. The mean of the last two is $24^{m.}\ 55{\cdot}395^{sec.}$, and that of 1861 is $24^{m.}\ 55{\cdot}38^{sec.}$ The value $24^{m.}\ 55{\cdot}40^{sec.}$ was adopted in (6) page 24 as the most probable. We may now conclude the longitudes of the three principal observatories east of Greenwich on the evidence of the telegraphic method alone, as follows, viz.:

	h.	m.	sec.	sec.
Longitudes of Port Darwin, IX..	8	43	22·34	± 0·152
Port Darwin to Adelaide Observatory (*x*)..	0	30	57·80	± 0·041
Longitude of Adelaide Observatory, X.. ..	9	14	20·14	± 0·157
Melbourne-Adelaide (*y*)..	0	25	33·84	± 0·050
Longitude of Melbourne Observatory..	9	39	53·98	± 0·165
Longitude of Port Darwin, IX..	8	43	22·34	± 0·152
Melbourne to Port Darwin (*x*,)..	0	56	31·65	± 0·044
Longitude of Melbourne Observatory, XI..	9	39	53·99	± 0·158
Sydney-Melbourne (*z*)..	0	24	55·40	± 0·091
Longitude of Sydney Observatory, XII....	10	04	49·39	± 0·182

Probable amount of Uncertainty of the Australian Longitudes.

It remains now to be seen with what degree of confidence the given results may be taken.

The theoretical errors attached to the longitudes of Adelaide, Melbourne and Sydney, found above, are respectively $\pm 0{\cdot}157^{sec.}$, $\pm 0{\cdot}158^{sec.}$, and $\pm 0{\cdot}182^{sec.}$ It has already been stated that these errors represent only that part of the probable uncertainty due to the disagreement of separate results of the same measure derived from each night's work when compared with their mean value. It would appear then that the really and purely accidental errors incurred in each single night of the period upon which a longitude result depends are fairly measured by the theoretical errors; or, if this measure is not quite satisfactory, is at least the best that can be obtained. But there may be involved systematic errors common to all the nights of that period, some of which are beyond the reach of investigation, and others that might possibly be discovered only by delicate and continued experiments in fixed institutions, but not in the temporarily arranged longitude observatories.

Altered personal equations at each new place of observation, instrumental changes, flexure, physical peculiarities of the localities, and many other known and unknown causes may bring in systematic errors not easily discovered. The theoretical error has no concern in these matters, and gives no help. It is when new instruments and new observers are employed in different years, so as to make the redeterminations entirely independent, that the existence of these systematic errors is revealed, if the results do not agree. But even then it is difficult, if not sometimes impossible, to

locate them. There are, besides, inaccuracies the causes of which are traceable, such as unsteadiness of stations, imperfect adjustment of electric instruments, changeable strength of circuits, level imperfections, unfavourable conditions such as having to carry time pieces to a distance, and others; but their effect can only be made evident by new measurements.

Every determination of differential longitude, however short the interval may be, is weakened by at least some of the causes here enumerated.

Admitting consummate skill in the great majority of the observers concerned, we may then look at the conditions under which this long longitude chain, Greenwich-Australia was developed, in order to see where its deficiency in strength is more especially to be feared.

There appears to be at first a natural division at Aden. The three intervals on the western portion were all measured twice, the results giving, as we have seen, the following discordances:

	sec.
Greenwich-Alexandria	0·156
Alexandria-Suez	0·156
Suez-Aden	0·177

Indeed, remembering the circumstances, these differences seem very small. Yet, although the aggregate error in the Aden longitude may not be more than one-fifth of their sum, it would not be unreasonable to suspect that it may amount to half a second of time or even more, for the unsteadiness of the stations at Alexandria and Suez and the great variations in the personal equation of the observer at Mokattam are serious matters.

The operations east of Aden all along to Australia were decidedly made under better conditions and with more complete equipments, and, unlike the others (which were only chiefly made for the purposes of the observations of the Transit of Venus), they were intended for the establishment of fundamental longitudes.

The portion from Aden to Madras depends on the elaborate and refined operations of the officers of the Great Trigonometrical Survey of India, of which the interval Aden-Bombay, with its two independent and extremely accordant values, obtained under such uneven share of advantages, offers a remarkable instance of how a good result is sometimes found where we might be justified by the nature of the case in giving it but little weight.

From Bombay to Madras the telegraphic results, though in every respect highly trustworthy, are not corroborated by any other entirely independent telegraphic determination. It appears also that the geodetic value of this interval, derived from the principal triangulation, is 12″·29—0·81$^{sec.}$ in excess of the telegraphic value, the difference being partly attributed to local attractions—(11) Preface, page xviii.

Up to this point we have another test for the whole of the operations in the longitude chain via Berlin-Ispahan-Kurrachee, and but for the doubts attached to the Kurrachee station this test would be invaluable.

We have now the determinations Madras-Singapore of 1871 and 1882. It is not unfair to assume the superiority of the latter value. The chief weakness of the earlier one arises, perhaps in the carriage of the chronometers to considerable distances for the exchange of signals, and in the unknown personal equation of the observer. There is a difference of more than half a second of time between the two results, and it is not quite certain, though most probable, that the whole of this error is attributable to the observations of Dr. Oudemans and Mr. Pogson. The interval Singapore to Port Darwin depends solely on one set of operations—viz., those of 1883. I can only say that the observers felt satisfied about the quality of their work; but still the receiving of galvanic signals by observing the sudden motion of a beam of light not always regular or well defined, involves greater uncertainty than transit observations, and may be subject to comparatively large variations in its amount. The result is

partly checked by the two separate intervals formed by the intervention of Banjoewangie, but is not corroborated by entirely independent operations. The difference between the direct and indirect result is 0·12s.

There remain now the Australian operations. In the two intervals Port Darwin to Adelaide and Port Darwin to Melbourne, the unknown error of the results rests almost entirely on the time determinations at Port Darwin, as the exchange of signals was entirely automatic, and transit observations at the fixed observatories involve very little uncertainty.

The various measurements of the interval Sydney-Melbourne, as we have repeatedly observed in these pages, range from 24m. 55·30s. to 24m. 55·81s., which may give reason to suspect some unknown disturbing cause interfering with this kind of work. Fortunately, fresh determinations may be frequently repeated without inconvenience, and I believe it is the intention of the government astronomers of these colonies to make arrangements for that purpose.

We have, finally, the boundary longitudes.

Here an error of more than half a second of time was disposed of in what was thought the only possible way under the circumstances; but it does not by any means clear the doubts attached to the discrepancies produced by the operations of 1868.

These are the principal facts upon which an opinion is to be formed as to the amount of uncertainty inherent to the adopted results.

I think that the longitudes of the Australian observatories may be accepted as true only within one second of time.

Possible Improvements of the Adopted Values.

No doubt, even with the present means of astronomical science, the Australian longitudes could be strengthened by a new determination of the longitude of Aden, as recommended by Dr. Gill, and of the interval Ispahan-Kurrachee. The importance of these operations could not be overrated, and it is to be hoped that they will be undertaken at the first opportunity.

APPENDIX—TABLE I.

Reference Letter.	Difference of Longitude.			Computed Mean Error.	Description of Interval for which the Difference of Longitude is given
	h.	m.	sec.	sec.	
(a)	2	05	06·240	0·098	Greenwich Mokattam (Cairo).
(b)	0	05	32·550	0·122	Alexandria (Hunter's station) to Mokattam
(c)	0	53	34·865	.....	Greenwich Berlin (Transit Circle).
(d)	0	04	28·316	0·058	Berlin Malta.
(e)	1	01	30·646	0·030	Malta Alexandria.
(f)	1	05	58·750	0·078	Berlin Alexandria. Dr. Copeland's value.
(f_1)	1	05	59·020	0·078	Berlin Alexandria. Dr. Auwers' value.
(g)	0	10	38·923	0·082	Alexandria (Hunter's station) to Suez (Low's station). Dr. Copeland's value.
(g_1)	0	10	39·078	0·082	Alexandria (Hunter's station) to Suez (Low's station). Dr. Auwers' value.
(h)	0	05	06·931	0·103	Mokattam Suez (Hunter's station)
(i)	0	00	00·320	...	...	Suez (Hunter's station, east of Low's station) to Dr. Gill's determination.
(i_1)	0	00	00·025	.	...	Suez (Hunter's station, east of Low's station) to Captain Campbell's traverse measurement.
(k)	0	49	43·750	0·120	Suez (Low's station) to Aden (Gill's station). Dr. Copeland's value.
(k_1)	0	49	43·733	0·120	Suez (Low's station) to Aden (Gill's station). Dr. Auwers' value
(k_{11})	0	49	42·562	0·060	Suez (Hunter's station) to Aden (Heaviside's station).
(l)	0	00	00·877	0·	Aden (Gill's station, east of Heaviside's station).
(m)	1	51	18·940	0·	Aden (Gill's station) to Bombay (Chamber's station, Colaba Observatory).
(m_1)	1	51	19·973	0·056	Aden (Heaviside's station) to Bombay (Heaviside's station).
(n)	0	00	00·334	. .	Bombay to Captain Heaviside's station (east of the Colaba Observatory Transit Instrument or Chamber's station).
(o)	0	29	43·530	0·058	Bombay (Heaviside's station) to Madras (Observatory Transit Circle).
(p)	2	33	05·440		Berlin Ispahan.
(q)	1	01	13·090		Ispahan Kurrachee (Addison's station).
(r)	0	53	06·220		Kurrachee Madras (Addison and Pogson). General Addison's value.
(r_1)	0	53	05·850		Kurrachee Madras (Addison and Pogson). Mr. Pogson's value.
(r_{11})	0	52	55·720		Kurrachee (Captain Campbell's station) to Madras Observatory. Determination by the officers of the G.T.S.
(s)	0	00	00·710	.	Kurrachee (Campbell's longitude station, west of Addison's station).
(t)	1	34	23·365		Madras (Observatory) to Singapore (flag staff on Fort Canning, 1871). Prof. Oudemans' value.
(t_1)	1	34	23·560		Madras (Observatory) to Singapore (flag staff on Fort Canning, 1871). Mr. Pogson's value.
(t_{11})	1	54	24·070	0·040	Madras (Observatory) to Singapore (Lieut. Norris' station).
(u)	1	47	57·480	0·046	Singapore (Lieut. Norris' and Captain Darwin's station) to Port Darwin (Baracchi's station).
(v)	0	00	01·510	.....	(Lieut. Norris' station is the same as Captain Darwin's station). (Darwin's station, east of flag staff on Fort Canning, 1871).
(w)	0	42	06·780	0·076	Singapore (Darwin's station) to Banjoewangie (Capt. Helb's).
(w_1)	1	05	50·840	0·091	Banjoewangie (Helb's station) to Port Darwin (Baracchi's station).
(x)	0	30	57·800	0·041	Port Darwin (Baracchi's station) to Adelaide (Observatory).
(y)	0	25	33·840	0·050	Melbourne (Observatory) to Adelaide (Observatory).
(x_1)	0	56	31·660	0·044	Port Darwin (Baracchi's station) to Melbourne (Observatory).
(z)	0	24	55·400	0·091	Sydney (Observatory) to Melbourne (Observatory).

II.—*List of Works Consulted.*

(1) Report on the Determination of Differences of Longitude in the West Indies and Central America. By Lieut.-Commander F. M. Green, U.S.N.

(2) Smithsonian Contributions to Knowledge, No. 223, vol. 16.

(3) Astronomische Nachrichten, No. 2636.

(4) United States Coast Survey Report. App. 18.

(5) Royal Astronomical Society, vol. 51.

(6) Report on the Telegraphic Determination of Australian Longitudes, via Singapore, Banjoewangie, and Port Darwin.

(7) Annals of the Cape Observatory, vol. i., Part II. (Dr. Gill.)

(8) Account of Observations of the Transit of Venus of 1874. (Edited by Sir George Airy.)

(9) Dunecht Observatory Publications, vol. iii. (By the Earl of Crawford and Balcarres.)

(10) Royal Astronomical Society, vol. 38. (General T. Addison, C.B.)

(11) Account of the Operations of the Great Trigonometrical Survey of India, vol. ix. (General J. T. Walker C.B., R.E., F.R.S., &c.)

(12) Report of the Great Trigonometrical Survey of India for 1876-77.

(13) Telegraphic Determinations of the Difference of Longitude between Karachi, &c., and the Government Observatory, Madras. (By Norman Pogson, C.I.E., F.R.A.S., &c., Government Astronomer.)

(14) Astronomische Nachrichten, No. 2486. (Prof. J. A. C. Oudemans.)

(15) Telegraphic Determination of Longitudes in Japan, China, &c. (By Lieut. Commanders F. M. Green and C. H. Davis and Lieut. J. A. Norris, U.S.N.)

(16) Royal Astronomical Society, vol. xlviii. (By John Tebbutt, F.R.A.S., &c.)

(17) Report on the Determination of the Boundary Line of Colonies of South Australia and New South Wales. (By Charles Todd, F.R.A.S., Observer and Superintendent of Telegraphs, South Australia, 14th December, 1868.)

Since Mr. Baracchi compiled the preceding, a fresh determination, Greenwich-Madras via Potsdam, has been made (1894-96) by Capt. Burrard and Capt. Conyngham, and still later (1903) a re-determination of Greenwich-Potsdam, whereby the preceding suffers a small correction so as to bring Capt. Burrard's value for Potsdam in accord with that of Professor Albrecht. From the recently published details of Professors Albrecht and Wanach's work, it would appear that we now have a practically absolute value for the difference of longitude Greenwich-Potsdam, and hence Berlin, that will not suffer material correction.

The meridian of Madras is the one of reference for the Great Trigonometrical Survey of India, and on its position the one of Singapore rests.

For over a century observations have been taken, from time to time to determine the longitude of Madras. In 1891 the survey of India had not adopted the then best value, so that at the International Geographic Congress held at Berne in that year the question arose, why the known error in longitude of 2′ 30″ was not corrected on the Indian maps and charts. This gave rise to a discussion in India and the whole longitude work was reviewed, with the result that a determination *de novo* was decided upon, carrying the work directly from Greenwich via Potsdam, Teheran, Bushire and Karachi, where connection was made with the three arcs of the Great Trigonometrical Survey between Karachi and Madras. This is the work referred to above and carried out in 1894-96.

In Volume xvii., Appendix No. 2—Great Trigonometrical Survey of India, 1901, Major S. G. Burrard, R. E., tabulates the various independent values of Madras into Series A, B, C, D and E.

Series A leads via Pulkowa to Vladivostock, with thirteen links, carried out by the Russian general staff, and thence by officers of the U.S. navy via Shanghai, Hong Kong, St. James, Singapore to Madras.

Series B was obtained in connection with the German Transit of Venus expeditions of 1874 and 1882, but owing to some serious error at Karachi, its value is rejected.

Series C gives the results of the most recent (1894-96) determination and the details are given in Capt. Burrard's report. The value for Madras of this series, corrected for Dr. Albrecht's value of Potsdam will be used for deducing Singapore. The difference between this new value for Singapore and the one adopted in the Singapore-

Port Darwin determination will be applied to the present value of Sydney, Brisbane, and Wellington for comparison with the Canadian longitudes brought across the Pacific.

Series D. -This leads via Berlin, Malta, Alexandria, Suez, Aden, Bombay and Bellary to Madras.

Mr. (now Sir) David Gill, who was one of the observers on this series, writes in volume I. of the Annals of the Cape Observatory: 'In the case of Lord Lindsay's Expedition (i.e. of Series D.) the observations lay no claim to high refinement. They were made throughout in the open air, with small portable instruments, which in the case of Alexandria were placed on the roof of a hotel, where the observer had to abstain from movement during each complete observation, otherwise the level was disturbed by the change of his position. At Aden and Alexandria the chronometers had to be carried a long distance between the observing station and the telegraph office. The observers were without personal assistance and the crucial observations for time had often to be made under conditions of extreme fatigue, amounting on one or two occasions nearly to exhaustion on the part of the observer engaged. In fact the character of the work was only such as it was possible to organize and execute en route, and the results fully realized the accuracy expected from them.'

Series E. This leads from Greenwich to Mokattam (Cairo) and thence to Suez and Madras as in Series D.

This series, too, Sir David Gill considers wanting in that refinement essential for fundamental longitudes.

The result of the five series of operations, Capt. Burrard tabulates as follows:

	Longitude of Madras h. m.	sec.	Probable Error. sec.
Series A	5 20	59·750	±·155
B		59·010	±·163
C		59·137	±·022
D		59·233	±·127
E		59·121	±·123

On the first link Greenwich-Potsdam of Series C, there is a check by another determination.

The adopted value of Berlin, as given in the Berliner Jahrbuch, up to 1903 is $0^h. 53^m. 34·910^{sec.}$

Berlin-Potsdam, $1^m. 18·721^{sec.}$, Astron. Geod. Arbeiten in 1891. Longitude Potsdam, $0^h. 52^m. 16·189^{sec.}$ By Series C, $0^h. 52^m. 15·953^{sec.}$, Vol. xvii. p. 208 G. T. S. India, or $·234^{sec.}$ less than the German value.

The value of Potsham of Series C, $0^h. 52^m. 15·953^{sec.}$ is the mean of the two values $0^h. 52^m. 15·623^{sec.}$ and $0^h. 52^m. 16·283^{sec.}$, obtained by exchange of stations by the observers Capt. Burrard and Capt. Conyngham. This gives a difference of $·660^{sec.}$ between the two results, and the personal equation is half, or $·330^{sec.}$, a quantity larger than had been obtained by direct observation therefor both at Greenwich and in India.

In 1903 a re-determination of Greenwich-Potsdam was carried out by Dr. Albrecht and Mr. Wanach. Stations were exchanged and the observations made with a Repsold registering micrometer. The whole work was carried out with so high a degree of refinement, that it is not probable that the work will ever require revision or repetition.

From the above 1903 determination, we have Potsdam $0^h. 52^m. 16·051^{sec.} \pm ·003^{sec.}$ p.e.* or $·098^{sec.}$ more than that of series C, and $·138^{sec.}$ less than the former German value.

New Zealand.

In volume 35 of the Transactions of the New Zealand Institute, Mr. T. King, observer at Wellington, gives a full account of the various determinations made for

* P. No. 15 Veröffentlichung des K. Preussischen Geodätischen Instituts.

the longitude of a prime meridian for New Zealand. This meridian, passing through the former Mount Cook observatory, is the one to which the surveys of New Zealand are referred. It may be remarked that the observatory was not on or near the well-known Mount Cook of the South or Middle island, but in Wellington on a site now occupied by prison buildings.

The longitude hitherto adopted for that meridian is $11^h\ 39^m\ 09{\cdot}92^{sec}$, derived from moon culminations, 1869-71. In 1876 a telegraphic difference of longitude was obtained between Sydney and Wellington by Messrs. Russell and Stock. However, as the accurate longitude of Sydney was at that time in doubt, no definitive meridian for New Zealand resulted from the 1876 work.

In 1883, as already noted, Sydney was connected with Greenwich by a chain of telegraphically connected stations entering Australia at Port Darwin, and the resulting longitude was $10^h\ 04^m\ 49{\cdot}54^{sec}$.†

In the same year Messrs. Russell and Adams connected Sydney with Wellington (Mount Cook station), obtaining a difference of longitude $1^h\ 34^m\ 16{\cdot}983^{sec}$ ($\pm{\cdot}020^{sec}$). (A very full and interesting account of this good work is given by Mr. C. W. Adams in the report on the surveys of New Zealand for the years 1883-84.)

This gave for the longitude of Mount Cook Initial Station, $11^h\ 39^m\ 06{\cdot}52^{sec}$.

This value is less than the hitherto accepted value by $3{\cdot}40^{sec}$, or 51 seconds of arc.

By triangulation a connection has been made between the Mount Cook station and the present observatory, both in Wellington. The latter was found east of the former $1{\cdot}21^{sec}$, so that the longitude of the present Wellington Observatory, is $11^h\ 39^m\ 05{\cdot}31^{sec}$ east of Greenwich.

This value is based on:

1883, Wellington-Sydney. Adams and Russell.
1883-84, Sydney-Melbourne-Port Darwin. Ellery, Todd, Russell, Baracchi.
1883, Port Darwin-Singapore. Baracchi, Capt. Darwin.

As Singapore is dependent upon Madras, whose longitude has already been discussed, all New Zealand longitudes, by accepting the last quoted longitude for Wellington, will be affected by any change in the value of Madras. Although the 1883 value for Mount Cook initial station was at the time considered definitive, yet its value has not for a period of twenty years thereafter, been introduced on the Admiralty Chart (except on No. 1423) nor on the maps of New Zealand. This was due to the great labour involved in changing the engraved plates.

Mr. T. King in his report,* writes: 'I undertsand, however, that the Surveyor General purposes taking advantage of an intended re-issue of the Department maps to revise the longitudes on the basis of Mr. Russell's and Mr. Adams' determination.'

The change of longitude by the $3{\cdot}40^{sec}$, will shift the topography relative to the meridians about three quarters of a mile to the west.

LATITUDE.

For the differential longitude determinations, the value for the latitude enters only for computation of the star factors, and was not required to be of such accuracy as in geodetic computations.

Vancouver.—The value used was that of former years, this station having been occupied at various times for longitudes in British Columbia:

$$\phi\ 49^\circ\ 17'\ 48''$$

Fanning Island.—Mr. Werry observed here 29 pairs of stars between the 19th April and 11th May, 1903, Talcott's method, and obtained the value:—

$$\phi\ +3^\circ\ 54'\ 37''{\cdot}53 \pm {\cdot}015''$$

† Report on the Telegraphic Determination of Australian Longitudes.—Melbourne, 1886
* Trans. New Zealand Institute, Vol. 35, p. 146

Suva, Fiji. Between June 27 and July 27, 1903, Dr. Klotz obtained here 28 pairs of stars from which the latitude was found to be:

$$\phi = 18^\circ\ 08'\ 45''{\cdot}02 \pm {}''{\cdot}014.$$

Norfolk Island.—Mr. Werry observed here 28 pairs of stars between Sept. 17 and 23, 1903, and obtained the value:

$$\phi = 29^\circ\ 00'\ 28''{\cdot}91 \pm {}''{\cdot}014.$$

Southport, Queensland. The transit instrument not being available for latitude work on account of the broken micrometer thread, several observations for latitude were taken by the method of observing pairs of stars at eastern and western elongation respectively, with a 6-inch transit theodolite, kindly loaned by Mr. A. A. Spowers, Chief Surveyor, Brisbane.

The mean value of three pairs was:

$$\phi = -27^\circ\ 58'\ 53''.$$

Brisbane.—The position of the observatory, where the observations were taken is (given in the Nautical Almanac):

$$\phi = -27^\circ\ 28'\ 00''{\cdot}0.$$

Sydney.—The position of the observatory, where the observations were taken is (given in the Nautical Almanac):

$$\phi = -33^\circ\ 51'\ 41''{\cdot}1.$$

Wellington.—The position of the observatory, where the observations were taken is:

$$\phi = -41^\circ\ 16'\ 47''{\cdot}1.$$

Doubtless Bay.—The observatory here was connected, through the courtesy of the Surveyor General, J. W. A. Marchant, by Mr. Vincent J. Blake, Government Surveyor, with Station 20 of the triangulation system, spread over the North Island.

The latitude of Station 20, based on initial Station Mt. Cook at Wellington, was furnished by the Surveyor General under date November 11, 1902, as

$$\phi = -34^\circ\ 58'\ 58''{\cdot}1$$

Applying it to Mr. Blake's survey we have:

Station 20—A..			22″·87
Station A..	34°	59′	20″·97
Station A—Observatory..	–		1″·07
Observatory..	– 34°	59′	22″·04

TRANSIT OBSERVATIONS

Station: VANCOUVER Date: April 10th 1903 Observer: Otto Klotz

Clamp	Star	Transit at mean of threads	Level and collimation equality errors	Azimuth	Collimation	Rate	Aberration	Seconds of error in transit	R. A.	Chronometer Correction	
		h m s	s	s	s	s	s		h m s	s	s
E	1.7	9 24 17 77	80	35	23	04	10	17 41	9 23 22 31	55 10	09
	119	29 14 01	47	03	01	03	02	13 80	28 18 79	01	09
	112.	41 17 88	15	01	01	02	02	17 71	40 22 59	12	02
	72	47 17 70	08	08	03	01	01	17 61	46 22 58	03	07
	123	56 02 42	10	06	03	00	02	02 27	55 07 11	16	06
	115.	10 02 59 87	12	05	03	00	02	59 71	10 02 04 56	15	05
W	148.	10 12 15 05	24	04	04	01	02	14 72	11 19 68	04	06
	149	17 30 65	32	02	04	02	02	30 27	16 35 16	11	01
	426.	23 14 10	30	02	04	02	02	13 74	22 18 56	18	08
	150	27 51 35	91	18	14	03	06	50 45	26 55 36	09	01
	431.	41 25 80	27	03	04	04	02	25 48	40 30 37	11	01
	432.	45 06 99	20	06	03	04	02	06 63	44 11 55	08	02

σ = ±.094 σ = .033

Chronometer correction at 10h 00m = 55s.098 ± .012

TRANSIT OBSERVATIONS

Station: VANCOUVER. Date, April 15th, 1906. Observer: OTTO KLOTZ

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of over transit.	R. A.	Chronometer Correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
						r = ·06					
E	127	8 11 38 51	·03	·04	·03	·05	·02	38 54	8 40 51 22	47 32	·13
	129	51 04 82	·02	·08	·03	·04	·01	04 90	50 17 45	·45	·00
	132	55 09 67	·04	·02	·04	·04	·02	09 71	54 22 34	37	·08
	133	57 49 33	·04	·00	·04	·04	·02	49 35	57 02 01	34	11
	134	9 10 08 04	·02	·08	·03	·03	·01	08 13	9 09 20 02	51	·06
	136	15 57 97	·03	·03	·04	·02	·02	58 03	15 10 49	54	·00
	137	24 09 32	15	·41	·21	·01	·10	09 16	23 21 68	48	·03
W	142	41 10 07	·08	·05	·03	·01	·02	10 00	40 22 50	50	·05
	423	55 54 47	·06	·07	·03	·02	·02	54 45	55 07 05	40	·05
	145	10 02 52 00	·07	·06	·03	·03	·02	51 97	10 02 04 50	·47	·02
	148	12 07 15	·08	·05	·03	·04	·02	07 11	11 19 62	·49	·04
	149	17 22 68	·11	·02	·04	·04	·02	22 57	16 35 07	·50	·05
	426	23 06 11	·10	·03	·04	·05	·02	06 03	22 18 48	·55	·10
	150	27 43·10	·31	·21	·13	·05	·06	42 44	26 55 04	·40	·05

a = +·111 c = +·030

Chronometer correction at 9h 34m 47s·453 ·014

W	433	10 53 04 18	·35	·28	·02	·03	·07	03 47	10 52 16 18	47 29	·02
	154	58 34 84	·17	·06	+·01	·02	·04	34 56	57 47 14	·42	·11
	434	11 00 50·18	·06	·08	+·01	·02	·02	50·17	11 00 02 82	·35	·04
	155	05 02 11	·11	·01	·01	·02	·02	01·98	04 14 82	·16	·15
	156	09 46 42	·08	·06	·01	·01	·02	46 38	08 59 04	·34	·03
E	160	11 16 57 38	·05	·08	·01	·01	·01	57·48	16 10·16	·32	·01
	162	26 29·27	·17	·12	·01	·0	·05	29·24	25 41 90	·34	·03
	163	41 45 14	·09	·00	·01	·02	·02	45 22	40 58 00	·22	·09
	164	44 56 01	·05	+·07	−·01	·02	·02	56 12	44 08 82	·30	·01
	166	49 33 40	·10	·02	·01	·03	·03	33 47	48 46 15	·32	·01
	167	12 01 05 43	·05	·08	·01	·04	·02	05 57	12 00 18 24	·33	·02

a = +·118 c = ·

Chronometer correction at 11h 23m 47s·309 ·016

r = ·056

E	177	13 08 10 13	·04	·01	·01	·04	·02	10 13	13 07 22·99	−47 14	·04
	178	20 50 75	·06	·01	·01	·03	·03	50 75	20 03 61	·14	·04
	452	24 29 88	·11	·09	·02	·02	·05	29 85	23 42·68	·17	·01
	179	30 54 50	·02	·02	−·01	·02	·01	34 52	29 47·32	·20	·02
	180	43 28 47	−·03	·02	+·01	·00	·02	28 51	42 41 34	·17	·01
	182	50 53 23	·03	·02	·01	·00	·02	53·27	50 06·14	·13	−·05
W	184	14 02 35 68	−·15	·02	·01	·01	·03	35 48	14 01 48·27	·21	·03
	458	06 47 86	·07	·01	·01	·02	·02	47 79	06 00 68	·11	·07
	459	10 04·29	−·20	·07	·03	+·02	−·07	03·85	09 16 72	·13	−·05
	188	13 31 22	−·10	·00	·01	+·02	·02	31 11	12 43 96	·15	·03
	190	22 43 31	·11	·00	·01	+·03	·02	43 20	21 55 88	·32	−·14
	192	28 28·41	−·07	·01	·01	−·04	·02	28 36	27 41 10	·26	−·08

a = +·029 c = +·007

Chronometer correction at 13h 48m 47s·181 −·013

TRANSIT OBSERVATIONS

Station: VANCOUVER. Date, April 16th, 1903. Observer: Otto K[illegible]

Clamp	Star	Transit over mean of threads.	Level and equality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of time transit.	R. A.	Chronometer correction.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s. s.
E	150.	10 27 41 11	15	26	12	05	06	40 71	10 26 54 98	45 73 02
	431	41 16 02	05	05	03	03	02	16 00	40 30 30	70 01
	432.	44 57 12	03	09	03	03	02	57 16	44 11 49	67 04
	152. ...	48 40 90	05	04	03	02	02	40 88	47 55 29	59 12
	434.	11 00 48 61	04	09	03	01	02	48 06	11 00 02 82	84 13
	155. ...	05 00 53	06	02	04	00	02	00 51	04 14 80	74 00
W	159.	14 02 39	21	-04	03	-01	02	02 18	13 16 48	70 01
	160.	16 55 82	14	-09	03	-01	01	55 74	16 10 15	59 12
	162. ..	26 28 22	39	14	08	-02	05	27 58	25 41 87	71 00
	438.	32 46 85	12	-10	03	-03	01	46 82	32 01 06	76 05
	164	44 54 65	13	-08	03	04	02	54 59	44 08 81	78 07

a = -·138 c = -·028

Chronometer correction at 11h 8m 45s·708 -·017

W	177.	13 08 08 47	01	06	06	05	02	08 51	13 07 23 00	45 51 05
	451.	13 59 33	01	-03	07	04	02	59 36	13 13 84	52 04
	178.	20 49 13	01	03	-09	03	03	49 12	20 03 61	51 05
	452.	24 28 44	03	20	-17	03	05	28 30	23 42 67	63 -07
	454.	31 15 59	01	-04	06	02	02	15 64	30 30 11	53 03
	180. ..	43 26 84	01	08	05	01	02	26 93	42 41 35	58 02
E	182.	50 51 68	08	-08	05	00	02	51 77	50 06 15	62 -06
	183.	57 30 40	06	-10	05	01	01	30 51	56 44 88	63 07
	184.	14 02 33 67	20	09	12	02	03	33 65	14 01 48 27	38 18
	458.	06 46 27	-09	-06	06	02	02	46 36	06 00 68	-68 12
	459.	10 02 58		-32	24	-03	07	02 35	09 16 73	62 06
	188.	13 29 43		-01	-07	03	-02	29 77	12 43 97	54 02
	192.	28 26 55	10	-05	06	-05	02	26 67	27 41 11	-56 00

a = -·139 c = -·050

Chronometer correction at 13h 48m 45s·561 -·017

TRANSIT OBSERVATIONS.

Station VANCOUVER Date, April 18th, 1903 Observer Orr-Ewing

Object	Star.	Transit over mean of threads	Level correction in seconds	Azimuth	Collimation	Rate	Mean time	Sidereal time of transit	R A	Chronometer error
		h m s	s	s	s	s	s	h m s	s	s
						0·03				
E	141	9 36 43 36	-·05	08	02	02	02 43 43	9 36 00 10	43 35	07
	142	41 05 76	06	06	05	02	02 05 81	40 22 46	35	07
	144	47 59 92	06	05	03	02	02 59 96	47 16 59	37	07
	145	55 50 46	-·05	08	02	03	02 50 44	55 07 01	43	03
	146	11 26 25 30	-·15	13	06	03	05 25 74	11 25 41 81	43	03
	148	37 14 37	03	10	02	03	01 14 50	32 01 05	45	05
W	152	10 48 38 72	06	04	03	01	02 38 72	10 47 55 28	44	04
	153	52 59 83	05	00	08	01	07 59 90	52 15 98	32	08
	154	56 45 50	12	06	05	02	04 45 45	56 01 67	48	08
	154	11 00 46 12	04	08	02	02	02 46 18	11 00 02 80	48	02
	155	04 58 16	08	01	03	02	02 58 12	04 14 78	34	06
	156	09 42 39	05	06	02	02	02 42 42	08 59 02	40	00
	159	15 59 90	07	04	03	02	02 59 90	13 16 46	44	04

γ = -·123 γ = 024

Chronometer correction at 10° 24′ 13 402 011

E	180	13 43 24 53	07	-·10	04	03	02 24 61	13 42 41 36	43 25	05
	182	50 49 31	08	10	04	02	02 49 41	50 06 16	25	05
	183	57 28 11	-·06	-·13	04	02	01 28 23	56 44 90	33	03
	184	14 02 31 60	-·19	11	09	01	03 31 56	14 01 48 29	26	04
	458	06 43 84	-·08	08	04	01	02 43 93	06 00 70	23	07
	459	10 00 45	-·35	43	18	01	07 00 11	09 16 75	36	06
	188	13 27 19	12	-·01	05	01	02 27 24	12 43 09	25	05
W	190	22 39 47	11	02	06	00	03 39 37	21 55 92	45	15
	192	28 24 45	07	-·07	04	00	02 24 48	27 41 13	35	05
	197	47 06 22	04	13	04	01	01 06 35	41 22 97	38	08
	198	51 45 59	22	28	14	01	05 45 19	51 01 98	21	09
	199	59 02 92	08	04	05	02	02 02 93	58 19 62	31	07
	465	15 01 02 69	07	-·08	04	02	02 02 74	15 00 19 46	28	07
	201	12 20 87	08	-·06	04	03	02 20 90	11 37 61	29	01

γ = -·186 γ = -0·36

Chronometer correction at 14° 28′ 43 302 -·010

TRANSIT OBSERVATIONS.

Station: VANCOUVER. Date: April 21st, 1903. Observer: [illegible]

Clamp.	Star.	Transit over mean of thread.	Level and azimuth.	A month.	Collimation.	Rate.	Aberration.	Nutation.	R A	Chronometer correction.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.
E 193		14 36 49 80	01	09	05	03	02	49 88	14 36 12 30	37 58 10
197		42 00 52	00	12	[illegible]	02	01	00 69	41 23 00	69 01
198		51 30 84	06	24		02	05	39 76	51 02 03	73 05
199		58 57 14	04	03	06	01	02	57 24	58 19 06	58 10
005		15 00 57 06	03	07	05	00	02	57 19	15 00 19 50	69 01
W 201		12 15 31	02	05	06	00	02	15 30	11 37 05	05 03
203		21 33 31	12	20	15	01	04	33 05	20 55 43	62 06
206		28 06 44	07	03	06	02	02	06 48	27 28 79	69 01
209		31 14 60	06	07	05	02	02	14 68	30 36 95	73 05
210		36 23 23	08	04	06	02	02	23 29	35 45 59	70 02
211		39 19 86	08	07	05	02	02	19 06	38 42 26	70 02
213		42 22 43	07	09	05	03	02	22 55	41 44 78	77 09

σ = ·159 σ = ·04.

Chronometer correction at 15h 10m 37s·677 ± ·013

TRANSIT OBSERVATIONS.

Station: VANCOUVER. Date, April 23rd, 1903. Observer: OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	ν.
		h. m. s.	s.	s.	s.	s. r = ·09	s.		h. m. s.	s.	s.
W	154.	10 58 21·94	·23	·08	-·06	·05	·04	21·60	10 57 46·92	34·68	-·05
	155.	11 04 49·48	·15	-·02	-·04	·04	·02	49·33	11 04 14·70	·63	·00
	156.	09 33·63	·10	-·09	+·03	·03	·02	33·60	08 58·96	·64	-·01
	159.	13 51·11	·13	-·06	-·03	·02	·02	51·03	13 16·40	·63	·00
	160.	16 44·64	-·08	-·12	+·03	·02	·02	44·67	16 10·09	·58	·05
E	162.	26 16·65	·08	·18	·08	-·01	·05	16·25	25 41·63	·62	·01
	438.	32 35·63	·02	-·13	·03	·00	·01	35·70	32 01·01	·69	-·06
	163.	41 32·52	·05	-·01	·04	+·02	·02	32·44	40 57·89	·55	·08
	164.	44 43·32	·03	-·10	·03	+·02	·02	43·36	44 08·77	·59	·04
	166.	49 20·81	-·05	-·03	·04	+·03	·02	20·70	48 46·03	·67	-·04
	167.	12 00 52·81	·02	-·11	·03	+·05	·02	52·90	12 00 18·21	·69	-·06

a = -·172 c = -·025

Chronometer correction at $11^h\ 29^m$ = 34·633 ± ·011

E	177.	13 07 57·49	·07	-·07	-·03	·06	·02	57·44	13 07 23·00	34·44	·01
	178.	20 38·20	·12	·03	+·04	-·03	·03	38·03	20 03·59	·44	·01
	452.	24 17·54	·22	·24	+·08	-·03	·05	17·08	23 42·61	·47	-·02
	454.	31 04·62	·09	-·04	+·03	·02	·02	04·56	30 30·12	·44	·01
	180.	43 15·84	·06	-·09	-·02	·00	·02	15·87	42 41·38	·49	-·04
W	182.	50 40·71	·07	-·09	·02	-·01	·02	40·70	50 06·18	·52	-·05
	183.	57 19·33	·05	-·13	·02	+·02	·01	19·40	56 44·93	·47	-·02
	184.	14 02 23·03	·18	·11	·05	+·03	·03	22·69	14 01 48·30	·39	·06
	458.	06 35·17	·08	-·08	·03	+·03	·02	35·15	05 60·73	·42	·03
	459.	09 52·12	·34	·40	·11	+·04	·07	51·24	09 16·76	·48	-·03
	190.	22 30·53	·13	·02	-·04	+·06	·03	30·37	21 55·95	·42	·03

a = -·173 c = -·023

Chronometer correction at $13^h\ 45^m$ = 34·451 ± ·008

TRANSIT OBSERVATIONS.

Station: VANCOUVER. Date, April 24th, 1903. Observer: OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and in equality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	154.	10 58 18·70	·02	·05	·02	·09	·04	19·42	10 57 46·89	32·53	·06
	156.	11 09 31·09	·01	·06	·01	·08	·02	21·45	11 08 58·95	·50	·03
	159.	13 48 45··	·50	·04	·01	·07	·02	18·89	13 16 39	·50	·03
	161.	19 26 30	·35	·07	·01	·06	·02	26·63	18 54 06	·57	·10
	166.	49 17·66	·75	·02	·02	·02	·03	18·32	48 46 01	·31	·16
W	170.	12 15 30·85	·22	·08	·01	·02	·02	31·16	12 14 58·79	·37	·10
	442.	21 38·30	·44	·02	·01	·03	·02	38·78	21 06 38	·46	·07
	171.	29 55·07	·94	·12	·03	·04	·04	55·92	29 23 43	·49	·02
	172.	37 18·99	·22	·08	·01	·05	·01	19·35	36 46 95	·40	·07
	174.	51 17·49	·24	·08	·01	·07	·01	17·88	50 45 28	·60	·13
	175.	52 03·59	·43	·03	·01	·08	·02	04·12	51 31·62	·50	·03
	451.	13 13 45·76	·45	·02	·01	·10	·02	46·32	13 13 13·84	·48	·01

a = +·110 c = +·010

Chronometer correction at 12h 01m 32·471 ±·020

TRANSIT OBSERVATIONS.

Station: VANCOUVER Date, April 25th, 1903. Observer: OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	v.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	184.	14 02 19·94	44	·08	·03	·05	03	19 31	14 01 48·30	31·01	+ ·07
	190.	22 27 13	32	− ·01	·02	·02	03	26 73	21 55 96	30 77	·17
	192.	28 12 37	21	− ·05	− ·01	·01	02	12 17	27 41·18	30·99	+ ·05
	194.	36 43 48	17	− ·07	·01	·00	02	43 35	36 12 33	31 02	+ ·08
W	197.	41 54 05	18	·09	+ ·01	·01	01	53 97	41 23·04	30·93	·01
	198.	51 34 06	88	19	+ ·06	− ·02	·05	33 02	51 02 07	30 95	+ ·01
	199.	58 50 97	34	02	+ ·02	− ·03	·02	50 68	58 19·70	30 98	+ ·04
	465.	15 00 50 64	27	− ·04	+ ·01	·03	02	50 43	15 00 19 54	30 89	− ·05
	201.	12 08 86	30	− ·05	+ ·01	− ·05	02	08 65	11 37·70	30·95	+ ·01

a = + ·124 c = + ·013

Chronometer correction at 12 30·943 ± ·020

TRANSIT OBSERVATIONS.

Station: VANCOUVER. Date, April 26th, 1903. Observer: OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction	r
		h. m. s.	s.	s.	s.	s. r = + ·10	s.		h. m. s.	s.	s.
E	150..	10 27 24·44	− ·22	− ·34	+ ·03	− ·09	− ·06	23 76	10 26 54·29	29·47	·11
	431..	40 59 72	− ·07	+ ·06	+ ·01	− ·07	− ·02	59·63	40 30 16	·47	·11
	432..	44 40·03	− ·05	+ ·11	+ ·01	− ·06	·02	40 92	44 11·38	·54	·04
	153..	56 3	·11	− ·04	+ ·01	− ·04	− ·03	31·21	56 01·48	·73	·15
	434..	11 00 32·[illegible]	− ·05	+ ·12	+ ·01	− ·03	− ·02	32·37	11 00 02 72	·65	·07
	155..	04 44·39	− ·08	+ ·02	+ ·01	− ·03	− ·02	44·29	04 14 64	·65	·07
	156..	09 28·62	− ·06	+ ·09	+ ·01	− ·02	− ·02	28·[illegible]	08 58 93	·69	·11
W	438..	32 30·49	− ·09	+ ·14	− ·01	+ ·02	− ·01	30·54	32 00·99	·55	·03
	163..	41 27·68	− ·21	+ ·01	− ·01	+ ·04	− ·02	27·49	40 57·85	·64	·06
	165..	46 10·12	− ·10	+ ·13	− ·01	+ ·04	− ·02	10·16	45 40·65	·51	·07
	166..	49 15·77	− ·24	− ·03	− ·01	+ ·05	− ·03	15·51	48 45·98	·53	·05
	167..	12 00 47·63	− ·11	+ ·12	− ·01	+ ·07	− ·02	47·68	12 00 18·19	·49	·09
	168..	08 13·67	− ·60	− ·42	− ·04	+ ·08	− ·07	12·62	07 43·01	·61	·03
	170..	15 28 19	− ·09	+ ·14	− ·01	+ ·09	− ·01	28 31	14 58·78	·53	·05

$a = +^s·179$ $c = +^s·008$

Chronometer correction at $11^h\ 20^m$ = − 29s·576 ± ·017

W	182..	13 50 35·71	− ·19	+ ·03	+ ·04	− ·07	− ·02	35·50	13 50 06·20	29·30	± ·04
	183..	57 14·34	− ·14	+ ·04	+ ·04	− ·06	− ·01	14 21	56 44·94	·27	± ·01
	458..	14 06 30·17	− ·20	+ ·02	+ ·04	− ·05	− ·02	29·96	14 05 60·74	·22	·04
	459..	09 46·88	− ·84	− ·11	+ ·18	− ·04	− ·07	46·00	09 16 74	·26	·00
	188..	13 13·46	− ·29	·00	+ ·05	− ·04	− ·02	13 16	12 44·03	·13	·13
	190..	22 25 43	− ·33	·00	+ ·06	− ·02	·03	25 11	21 55·[illegible]	·14	± ·12
	192..	28 10·62	− ·13	+ ·04	+ ·04	− ·01	− ·01	10 55	27 41·19	·36	± ·10
E	197..	41 52·32	− ·03	+ ·04	− ·04	+ ·01	− ·01	52·29	41 23·05	·24	·02
	198..	51 31·79	− ·17	− ·07	− ·14	+ ·02	− ·05	31·38	51 02·08	·20	± ·04
	199..	58 49·02	− ·06	+ ·01	− ·05	+ ·04	·02	48·94	58 19·71	·23	·03
	465..	15 00 48·93	− ·05	+ ·02	− ·04	+ ·04	− ·02	48·88	15 00 19·55	·33	± ·07
	201..	12 07·05	− ·06	+ ·02	− ·04	+ ·06	− ·02	07·01	11 37·71	·30	± ·04
	202..	21 21·04	− ·06	+ ·01	− ·05	+ ·07	− ·02	20 99	20 51·70	·29	± ·03

$a = +^s·049$ $c = -^s·037$

Chronometer correction at $14^h\ 35^m$ = − 29s·260 ± ·015

TRANSIT OBSERVATIONS.

Station: FANNING ISLAND. Date, April 15th, 1903. Observer: F. W. O. WERRY.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	v.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
E	149	10 15 20·14	+·09	·29	·53	·11 ·06	-·02	19·33	10 16 35·07	-1 15·74	·13
	574	20 10·45	-·09	·13	·41	·05	·02	10·19	21 25·93	·74	-·13
	127	23 12·72	-·10	·51	·71	·04	·02	11·54	24 27·50	·96	·09
	ρ Leonis	26 28·63	-·09	·04	·40	·03	·02	28·23	27 44·18	·95	·08
	576	35 14·47	-·09	·03	·40	·02	·02	14·15	36 36·05	·90	·03
W	ι Antliæ	50 57·83	·02	-·29	·49	·01	·02	58·58	52 14·54	·96	·09
	d Leonis	54 18·96	-·02	·00	·40	-·02	·02	19·34	55 35·10	·76	-·11
	434	58 46·73	-·02	·02	-·40	·02	·02	47·09	11 00 02·82	·75	-·14
	578	11 05 38·98	-·02	·17	-·43	-·04	·02	39·58	06 55·48	·90	-·03
	156	07 42·83	-·02	·11	-·42	-·04	-·02	43·14	08 59·04	·90	-·03
	579	13 15·15	-·02	·11	-·41	·05	·02	15·68	14 31·64	·96	·09

a = -·355 c = -·396

Chronometer correction at $10^h\ 45^m$ $1^m\ 15^s·865$ -·021

W	τ Leonis	11 21 42·72	-·03	·09	·41	·07	-·02	43·01	11 22 59·06	-1 16·05	·04
	581	26 59·65	-·03	-·33	·48	·06	-·02	60·35	28 16·38	16·03	·02
	438	30 44·82	-·03	-·03	-·41	·05	-·02	45·16	32 01·07	15·91	-·10
	164	42 52·49	-·03	·10	·43	·03	·02	52·74	44 08·82	16·08	·07
	B Centauri	45 03·70	-·03	-·52	·58	·03	-·03	04·71	46 20·76	16·05	·04
	π Virginis	54 40·03	-·03	·03	-·41	·01	·01	40·36	55 56·30	15·94	-·07
E	582	12 03 55·05	-·05	-·23	·44	-·01	-·02	54·78	12 05 10·63	15·85	-·16
	170	13 43·35	-·05	-·02	·41	-·02	-·02	42·92	14 58·82	[illegible]	-·11
	584	23 37·44	-·05	-·17	·43	-·04	·02	37·15	24 53·14		·02
	585	28 04·13	-·05	-·24	·44	·05	·02	03·91	29 20·04	16	
	172	35 31·18	-·05	-·04	·41	-·06	-·02	30·80	36 46·96	16·16	
	31 Comæ	45 45·34	-·05	-·23	-·46	-·08	-·02	44·66	47 00·65	15·98	-·02

a = -·495 c = -·410

Chronometer correction at $12^h\ 00^m$ -$1^m\ 16^s·005$ -·023

TRANSIT OBSERVATIONS.

Station: FANNING ISLAND. Date, April 16th, 1903. Observer: F. W. O. WERRY.

Class.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s. r = ·19	s.		h. m. s.	m. s.	s.
E	γ Cancri	8 36 22 44	·05	·04	·19	·14	·02	22·46	8 37 41 85	1 19 39	·07
	α Mali	38 23 60	·05	·10	·21	·13	·02	23 51	39 43 03	·52	·06
	127	39 31 65	·06	·07	·20	·13	·02	31 71	40 51 [illegible]	·48	·02
	131	51 53 09	·07	·02	·18	·09	·02	53 11	53 12 43	·32	·14
	132	53 02 62	·07	·12	·24	·09	·03	02 79	54 22 32	·53	·07
	133	55 42·30	·08	·14	·26	·08	·03	42 51	57 01·99	·48	·02
W	κ Cancri	9 01 11 94	·02	·02	·18	·06	·02	11 68	9 02 31·18	·50	·04
	142	39 03·13	·02	·05	·19	·06	·02	03 01	40 02 49	·48	·02
	143	42 48 51	·03	·23	·35	·07	·06	48 37	44 07 81	·44	·02
	572	45 03 23	·02	·02	·18	·08	·02	03 07	46 22 49	·42	·04
	ω Leonis	45 57 31	·02	·06	·20	·08	·02	57 21	47 16·62	·41	·05
	423	53 47·70	·02	·01	·18	·10	·02	47 59	55 07 03	·44	·02
	145	10 00 45 00	·02	·03	·19	·14	·02	44·94	10 02 04 49	·55	·09

a = ·142 c = ·177

Chronometer correction at 9h 20m = 1m 19s·456 ± ·014

W	576	10 35 10 67	·05	·02	·25	·08	·02	10 25	10 36 30·05	1 19 89	·03
	431	39 10·76	·05	·14	·29	·06	·02	10 48	40 30·30	·82	·05
	μ Argûs	41 15 68	·05	·31	·38	·06	·02	18·86	42 38 63	·77	·00
	577	43 33·14	·05	·09	·26	·05	·03	32 66	44 52 42	·76	·01
	ι Antliæ	50 55 29	·05	·21	·31	·03	·02	54 67	52 14 54	·87	·10
	d Leonis	54 15 84	·05	·00	·25	·02	·03	15 49	55 35 10	·61	·16
E	155	11 02 54 44	·01	·24	·35	·01	·02	55·01	11 04 14 80	·79	·02
	578	05 35 52	·00	·13	·27	·02	·03	35·65	06 55 47	·82	·05
	156	07 38 92	·00	·09	·26	·02	·02	39 27	08 59 07	·80	·03
	579	13 11 7	·00	·09	·25	·04	·02	11·91	14 31 63	·72	·05
	160	14 50 23	·00	·01	·25	·04	·02	50 51	16 10·15	·64	·13
	τ Leonis	21 38·87	·00	·00	·25	·06	·02	39·16	22 59·06	·90	·13
	188	30 41 03	·00	·02	·25	·09	·02	41 33	32 01 06	·73	·04

a = ·261 c = +·246

Chronometer correction at 11h 00m = 1m 19s·770 ± ·017

TRANSIT OBSERVATIONS.

Station : FANNING ISLAND. Date, April 18th, 1903. Observer : F. W. O. WERBY.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	r.
		h. m. s.	s.	s.	s.	s. r = + ·22	s.		h. m. s.	m. s.	s.
E	129	8 47 51·09	+ ·03	− ·01	+ ·30	− ·27	− ·02	51·12	8 50 17 40	+2 26 28	− ·20
	133	54 35·90	+ ·04	− ·29	+ ·43	− ·24	− ·03	35·81	57 01·94	·13	− ·05
	α Cancri	9 00 05·05	+ ·03	− ·03	+ ·30	− ·22	− ·02	05·11	9 02 31·15	·04	+ ·04
	134	06 54·40	+ ·03	+ ·01	+ ·30	− ·20	− ·02	54·52	09 20·58	·06	+ ·02
	417	11 09·68	+ ·03	− ·07	+ ·31	− ·18	− ·02	09·75	13 35·65	25·90	+ ·18
W	ρ Leonis	10 25 18·42	+ ·01	− ·09	− ·30	+ ·09	− ·02	18·11	10 27 44·14	26·03	+ ·05
	434	57 36·96	+ ·01	− ·05	− ·30	+ ·21	− ·02	36·81	11 00 02·80	25·99	+ ·09
	155	11 01 49·68	·00	− ·81	− ·42	+ ·22	− ·03	48·64	04 14·77	26·13	− ·05
	578	04 29·01	− ·01	+ ·42	− ·32	+ ·23	− ·02	29·31	06 55·46	·15	− ·07
	157	06 45·21	− ·02	− ·20	− ·31	+ ·24	− ·02	44·90	09 11·00	·10	− ·02

$a_1 = +^s·280$ $a_2 = +^s·875$ $c = +^s·296$

Chronometer correction at $10^h\ 00^m = +2^m\ 26^s·081 \pm ^s·026$

W	579	11 12 05·21	− ·02	+ ·26	− ·30	− ·14	− ·02	04·99	11 14 31·62	+2 26·63	− ·15
	160	13 44·17	− ·03	− ·03	− ·29	− ·13	− ·02	43·67	16 10·13	·46	+ ·02
	164	41 42·97	− ·03	·16	− ·30	− ·03	− ·02	42·43	44 08·81	·38	+ ·10
	166	46 21·27	− ·03	− 1·07	− ·50	− ·01	− ·04	19·62	48 46·10	·48	·00
E	167	11 57 51·58	− ·05	− ·07	+ ·29	+ ·03	− ·02	51·86	12 00 18·23	·37	+ ·11
	582	12 02 43·31	+ ·04	+ ·38	+ ·31	+ ·04	− ·02	44·06	05 10·62	·56	− ·08
	169	08 14·06	+ ·05	− 1·23	+ ·54	+ ·07	− ·04	13·45	10 40·02	·57	− ·09
	170	12 31·77	+ ·05	+ ·06	+ ·29	+ ·08	− ·02	32·23	14 58·81	·58	− ·10
	585	26 52·71	+ ·04	+ ·40	+ ·31	+ ·13	− ·02	53·57	29 20·03	·46	+ ·02
	ρ Virginis	34 34·02	+ ·05	− ·10	+ ·30	+ ·16	− ·02	34·41	37 00·73	·32	+ ·16

$a = +^s·819$ $c = +^s·290$

Chronometer correction at $11^h\ 50^m = +2^m\ 26^s·481 \pm ^s·025$

TRANSIT OBSERVATIONS.

Station: FANNING ISLAND. Date, April 23rd, 1903. Observer: F. W. O. WERRY.

Class.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	σ
		h. m. s.	s.	s.	s.	s. (r = + ·17)	s.		h. m. s.	s.	s.
E	λ Argûs	9 03 40 30	+ ·06	+ ·52	+ ·37	− ·07	·03	41·15	9 04 27 23	46·08	·08
	134	08 34 04	+ ·04	+ ·01	+ ·27	− ·06	·02	34 28	09 20 50	·22	·06
	417	12 49 36	+ ·04	− ·14	+ ·28	·04	·02	49·48	13 35 57	·09	·07
	136	14 24 25	+ ·04	− ·33	+ ·33	·04	·03	24 22	15 10 31	·12	·04
	h Mali	16 26·56	+ ·03	+ ·28	+ ·30	− ·04	·02	27 11	17 13 34	·23	·07
W	ψ Argûs	26 08·21	− ·02	+ ·48	− ·35	− ·01	·03	08 28	26 54 42	·14	·02
	419	27 33·17	− ·03	− ·36	− ·33	− ·01	·03	32 41	28 18 54	·13	·03
	κ Hydræ	34 54·94	− ·05	+ ·16	− ·28	+ ·01	·02	54 76	35 40 96	·20	·04
	572	45 36·49	− ·06	+ ·07	− ·27	+ ·04	·02	36 25	46 22 39	·14	·02
	422	51 01·00	− ·07	− ·42	− ·36	+ ·06	− ·03	00 18	51 46 41	·23	·07
	423	54 21·13	− ·09	− ·04	·27	+ ·08	·02	20 79	55 06 94	·15	·01

$a = +^{s}\cdot523$ $c = +^{s}\cdot267$

Chronometer correction at $9^h\ 30^m = +46^s\cdot157 \pm ^s\cdot012$

W	427	10 23 42·45	− ·10	− ·92	− ·40	− ·08	− ·04	40·91	10 24 27 29	+46·38	·00
	ρ Leonis	26 58·18	− ·07	− ·06	− ·22	− ·07	− ·02	57·74	27 44 38	·34	·04
	576	35 43·92	− ·07	+ ·06	− ·22	− ·04	·02	43 63	36 29 27	·34	·04
	α Argûs	41 51·76	− ·07	+ ·77	− ·33	− ·02	·03	52·08	42 38 48	·49	·02
	d Leonis	54 48·92	− ·07	− ·01	− ·22	+ ·01	− ·02	48 61	55 35·03	·42	·04
E	578	11 06 08 52	− ·05	+ ·31	+ ·24	+ ·04	− ·02	09 04	11 06 55·41	·37	·01
	157	08 24 48	− ·06	− ·15	+ ·23	+ ·06	·02	24 54	09 10·97	·43	·05
	579	13 44·79	− ·05	+ ·20	+ ·23	− ·07	·02	45 22	14 31 58	·36	·02
	160	15 23·56	·06	− ·03	+ ·22	+ ·07	·02	23 74	16 10 09	·35	·03
	τ Leonis	22 12·33	− ·06	+ ·01	+ ·22	+ ·08	·02	12 56	22 59 00	·44	·06
	581	27 29·22	− ·05	+ ·43	+ ·26	+ ·11	− ·02	29 95	28 16 31	·36	·02

$a = +^{s}\cdot640$ $c = +^{s}\cdot220$

Chronometer correction at $10^h\ 50^m = +46^s\cdot382 \pm ^s\cdot008$

TRANSIT OBSERVATIONS.

Station: FANNING ISLAND. Date, April 26th, 1903 Observer: F. W. O. WERRY.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	r.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	h Mali	9 16 14·08	−·10	+·25	+·20	−+·16	·14	·02 14·27	9 17 13·28	+59·01	−·02
	140	25 25·34	−·10	·56	+·29	−·12	·03	24·82	26 23·92	59·10	·07
	419	27 19·78	·11	·31	−·23	−·12	−·03	19·44	28 18·49	59·05	·02
	142	39 23·43	·12	−·17	+·20	·08	·02	23·24	40 22·33	59·09	·06
	572	45 23·30	−·10	+·06	+·18	·07	·02	23·35	46 22·35	59·00	−·03
	α Leonis	46 17·71	−·10	−·20	+·20	−·06	·02	17·53	47 16·46	58·93	−·10
W	423	54 08·16	−·09	·04	−·18	−·04	·02	07·79	55 06·91	59·12	·09
	145	10 01 05·81	−·09	−·11	·19	−·03	−·02	05·37	10 02 04·34	58·97	+·06
	573	04 54·41	−·09	+·13	·18	−·02	·02	54·23	05 53·28	59·05	·02
	γ Velorum	09 42·70	−·09	+·44	·24	·00	−·03	42·78	10 41·86	59·08	·05
	149	15 36·46	−·09	·38	−·24	+·01	·03	35·73	16 34·86	59·13	·10
	434	59 03·91	−·03	·03	·18	+·13	−·02	03·78	11 00 02·73	58·95	+·08
	155	11 03 16·29	−·03	−·43	·25	+·14	·03	15·69	04 14·64	58·95	−·08

$a = +^s\,459$ $c = +^s\,180$

Chronometer correction at $10^h\ 10^m = +59^s\,034 - ^s\,015$

W	157	11 08 12·13	−·02	−·13	−·24	−·08	−·02	11·64	11 09 10·94	+59·30	−·02
	579	13 32 42	−·02	+·19	−·24	−·07	−·02	32·26	14 31·55	·29	−·01
	160	15 11 08	−·02	·02	−·23	−·06	−·02	10·73	16 10·06	·33	−·05
	τ Leonis	22 09·06	·01	+·01	−·23	−·04	·02	59·77	22 58·97	·20	+·08
	581	27 16·87	·01	+·39	−·27	−·04	−·02	16·92	28 16·28	·36	−·08
	438	31 01·96	−·01	+·04	−·23	−·03	−·02	01·71	32 00·99	·28	·00
E	163	39 58·79	+·02	−·61	+·35	·00	·03	58·52	40 57·85	·33	−·05
	B Centauri	45 20·42	+·02	+·60	+·33	+·02	−·03	21·36	46 20·56	·20	−·08
	π Virginis	54 56·83	−·02	−·03	+·23	+·04	·02	57·07	55 56·26	·19	+·09
	167	59 18·71	+·01	−·05	+·23	+·05	·02	18·93	12 00 18·19	·26	−·02
	169	12 09 40·96	+·02	·87	+·43	+·08	−·04	40·58	10 39·89	·31	−·03
	170	13 59·14	+·01	+·04	+·23	+·09	−·02	59·49	14 58·78	·29	−·01

$a = +^s\,579$ $c = +^s\,231$

Chronometer correction at $11^h\ 40^m = +59^s\,278 + ^s\,012$

TRANSIT OBSERVATIONS.

Station: FANNING ISLAND. Date, June 2nd, 1903. Observer: F. W. O. WEBB.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s. r − ·10	s.		h. m. s.	s.	s.
E	179	13 30 01·77	·05	+ ·03	+ ·10	·08	·02	01·75	13 29 47·28	−14·47	+ ·05
	ω Virginis	36 47·98	·05	+ ·10	+ ·10	·07	·02	48·04	36 33·68	·36	·06
	180	42 55·97	·05	·12	+ ·10	·05	·02	55·83	42 41·29	·54	+ ·12
	588	44 52·88	·05	+ ·18	+ ·10	·05	·02	53·04	44 38·65	·39	·03
	182	50 20·75	·05	·13	+ ·10	·04	·02	20·61	50 06·12	·49	+ ·07
	457	57 03·43	·05	·22	+ ·11	·03	·02	03·22	56 48·75	·47	+ ·05
W	192	14 27 56·08	+ ·14	·25	+ ·11	+ ·02	·02	55·58	14 27 41·19	·39	·03
	196	38 14·07	+ ·13	+ ·08	+ ·10	+ ·04	·02	13·94	37 59·48	·46	+ ·04
	590	45 48·10	·13	+ ·17	·10	+ ·05	·02	48·07	45 33·53	·54	+ ·12
	463	51 55·52	·14	+ ·09	+ ·10	+ ·06	·02	55·23	51 40·93	·30	·12
	199	58 34·74	·14	·38	+ ·14	+ ·07	·03	34·12	58 19·78	·34	·08
	465	15 00 34·34	+ ·14	·21	·11	+ ·08	·02	33·94	15 00 19·69	·25	·17

a = ·476 c = ·096

Chronometer correction at 14h 15m = −14s·419 ± ·020

W	592	15 06 58·87	+ ·13	+ ·33	·12	·07	·02	58·86	15 06 44·48	−14·38	+ ·05
	466	10 39·26	·13	+ ·02	·11	·06	·02	38·92	10 24·63	·29	·04
	201	11 53·05	·13	·48	+ ·13	·06	·02	52·23	11 37·88	·35	+ ·02
	γ Lupi	28 58·23	+ ·13	+ ·74	·14	·03	·03	58·64	28 44·37	·27	·06
	593	30 23·27	+ ·13	+ ·25	·11	·03	·02	23·23	30 08·90	·33	·00
E	221	16 06 00·21	·07	·75	+ ·15	+ ·03	·03	59·54	16 05 45·29	·25	·08
	222	09 32·69	+ ·06	+ ·10	+ ·11	+ ·03	·02	32·85	09 18·51	·34	+ ·01
	223	13 28·28	·06	+ ·12	+ ·11	+ ·04	·02	28·47	13 14·11	·36	+ ·03
	225	17 55·46	+ ·06	+ ·22	+ ·12	+ ·05	·02	55·33	17 41·01	·32	·01
	473	21 13·35	·06	·14	+ ·11	+ ·06	·02	15·30	20 58·96	·34	+ ·01
	λ Ophiuchi	26 18·25	+ ·06	+ ·02	+ ·11	+ ·06	·02	18·36	26 04·02	·34	+ ·01
	230	31 16·01	·06	+ ·68	+ ·15	+ ·07	·03	15·46	31 01·09	·37	+ ·04

a = + ·796 c = + ·109

Chronometer correction at 15h 48m = −14s·530 ± ·009

TRANSIT OBSERVATIONS.

Station: FANNING ISLAND. Date, June 3rd, 1906. Observer: F. W. O. WERRY.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	v.
		h. m. s.	s.	s.	s.	s. v = + ·10	s.		h. m. s.	s.	s.
E	179	13 29 59·75	·01	·05	·12	·07	·02	59·84	13 29 47·27	12·57	·09
	ω Virginis	36 46·04	·01	·14	·12	·06	·02	46·23	36 33·67	·56	·08
	180	42 53·82	+·01	·16	·13	·05	·02	53·73	42 41·29	·44	·04
	588	44 50·78	·01	+·25	·13	·04	·02	51·11	44 38·65	·46	·02
	182	50 18·68	+·01	·18	·13	·03	·02	18·59	50 06·12	·47	·01
	457	57 01·46	+·01	·30	·14	·02	·02	01·27	56 48·74	·53	·05
	π Hydræ	14 01 05·62	+·01	+·36	·14	·01	·02	06·10	14 00 53·74	·36	·12
W	186	11 10·77	−·04	·10	·12	·00	·02	10·69	10 58·15	·54	·06
	188	12 57·15	−·05	·64	·18	·00	·03	56·25	12 43·84	·41	·07
	191	23 27·39	−·04	+·06	·12	+·02	·02	27·29	23 14·78	·51	·03
	192	27 54·11	−·05	−·34	·14	+·03	·02	53·59	27 41·19	·40	·08
	196	38 11·95	−·04	+·10	·12	+·05	·02	11·92	37 59·47	·45	·03
	e^2 Bootis	41 00·34	−·05	·29	·13	+·05	·02	59·90	40 47·34	·56	·08
	463	51 53·68	−·05	−·12	·13	+·07	·02	53·43	51 40·92	·51	·03

$a = +^s·649$ $c = +^s·121$

Chronometer correction at $14^h\ 10^m = -12^s·484 \pm ^s·013$

W	199	14 58 32·77	−·05	−·52	−·05	−·04	−·03	32·08	14 58 19·78	−12·30	·08
	465	15 00 32·58	−·05	·30	·05	−·03	·02	32·13	15 00 19·68	·45	·07
	592	06 56·74	−·04	+·28	−·04	−·02	·02	56·90	06 44·48	·42	·04
	201	11 50·80	−·05	−·39	−·05	−·01	·03	50·27	11 37·87	·40	·02
	o^2 Libræ	17 52·30	−·04	+·22	−·04	·00	·02	52·42	17 40·08	·34	−·04
E	468	21 32·36	+·02	−·14	+·04	·00	·02	32·26	21 19·94	·32	−·06
	469	34 35·88	+·02	−·53	+·05	+·02	·03	35·41	34 22·99	·42	+·04
	210	35 58·65	+·02	−·45	+·05	+·03	·03	58·27	35 45·90	·37	−·01
	211	38 55·19	+·02	−·22	+·05	+·03	·02	55·65	38 42·62	·43	+·05
	213	41 57·59	+·02	−·14	+·04	+·04	−·02	57·53	41 45·18	·35	−·03
	215	44 37·40	+·02	−·17	+·05	+·04	−·02	37·32	44 24·92	·40	+·02

$a = +^s·656$ $c = +^s·043$

nometer correction at $15^h\ 19^m = -12^s·377 \pm ^s·011$

TRANSIT OBSERVATIONS.

Station: FANNING ISLAND. Date, June 8th, 1903. Observer: F. W. G. WEBBY.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit	R. A.	Chronometer correction.	r.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	182	13 50 10 01	+ ·02	− ·10	+ ·02	− ·07	02	09 86	13 50 06 08	03·78	·09
	457	56 52 72	+ ·02	− ·17	+ ·02	·06	02	52 51	56 43 70	·81	·06
	458	14 06 04 80	+ ·03	− ·15	+ ·02	− ·04	02	04 64	14 05 60 65	·99	·12
	186	11 01 97	+ ·03	+ ·08	+ ·02	− ·03	02	02 03	10 58 13	·90	·03
	188	12 48 09	+ ·03	·39	+ ·02	·03	03	47 72	12 43 78	·94	·07
	1·4	36 16 26	+ ·03	− ·08	+ ·02	+ ·01	02	16 22	36 12 40	·82	·05
W	463	51 44 77	− ·01	·07	− ·02	+ ·03	02	44 68	51 40 92	·76	·11
	199	58 23 92	− ·01	− ·29	− ·02	+ ·05	02	23 63	58 19 75	·88	·01
	465	15 00 23 64	·01	− ·17	·02	+ ·05	03	23 46	15 00 19 67	·79	·08
	592	06 48 14	− ·01	+ ·15	·02	+ ·06	·02	48 30	06 44 70	·80	·07
	466	10 28 54	·00	·01	− ·02	+ ·07	02	28 56	10 24 62	·94	·07
	201	11 42 12	·00	− ·22	− ·02	+ ·07	03	41 92	11 37 86	04·06	·19
	σ^2 Libræ.	17 43·75	·00	+ ·12	− ·02	+ ·08	02	43 91	17 40 07	03·84	·03

$a = +^s·368$ $c = +^s·015$

Chronometer correction at $14^h 30^m$ = $3^s·866 - ·021$

W	202	15 20 55 97	− ·06	− ·34	− ·03	− ·06	03	55 57	15 20 51 87	03·70	·01
	ν^1 Libræ.	22 54 75	+ ·06	+ ·18	− ·03	− ·06	02	53 88	22 50 11	·77	·06
	206	27 33 16	+ ·06	− ·39	− ·03	− ·04	03	32 73	27 29 04	·69	·02
	207	28 25 19	+ ·06	− ·39	− ·03	− ·04	02	24 77	28 21 15	·62	·06
	593	30 12 60	+ ·06	+ ·16	− ·03	− ·03	02	12 74	30 08 93	·81	·10
	409	34 27 07	+ ·06	− ·39	·03	·03	02	26 65	34 23 00	·66	·05
	213	41 49 02	+ ·06	− ·10	− ·03	·02	02	48 91	41 45 19	·72	·01
E	σ Scorpii..	16 15 24 13	+ ·10	+ ·26	+ ·03	+ ·04	02	24 54	16 15 20 87	·67	·04
	225	17 44 88	+ ·09	− ·14	+ ·03	+ ·04	02	44 88	17 41 05	·83	·12
	473	21 02·62	·09	·09	·03	·05	02	02 68	20 58 95	·73	·02
	227	26 07 70	·09	+ ·01	+ ·03	+ ·06	·02	07 87	26 04 06	·81	·10
	τ Scorpii..	29 57 09	·10	+ ·29	+ ·03	− ·06	02	57 55	29 54 05	·50	·21
	597.	31 55·49	·09	+ ·12	+ ·03	+ ·07	02	55 69	31 52 00	·69	·02

$a = +^s·488$ $c = +^s·0·6$

Chronometer correction at $15^h 50^m$ = $3^s·706 - ·018$

TRANSIT OBSERVATIONS.

Station: FANNING ISLAND. Date, June 9th, 1903. Observer F. W. O. W[illegible]

Clamp	Star	Transit over mean of threads.	Level and equal pivots	Azimuth	Collimation	Rate	Aberration.	Correction over transit	R. A.	Chronometer correction	
		h m s	s	s	s	s	s		h m s	s	s
E	158	14 06 03 32	07	21	10	05	02	03 21	14 06 00 61	02 57	02
	188	12 46 74	08	·51	12	04	03	46 36	12 43 76	60	01
	192	27 [illegible] 81		27	10	03	02	43 71	27 41 15	56	03
	194	36 14 99	[illegible]	12	09	02	02	[illegible]	36 12 40	64	05
	463	51 43 41	·12	[illegible]	09	01	02	[illegible]	51 40 92	57	02
W	502	15 06 46 84	·06	22	09	01	02	47 02	15 06 44 50	52	07
	466	10 27 30	·10	01	09	01	02	27 29	10 24 62	67	08
	201	11 40 85	·10	·31	10	01	03	40 52	11 37 85	·67	[illegible]
	202	20 54 79	·11	·36	11	02	03	54 42	20 51 87	55	04
	205	23 54 89	11	26	10	02	02	54 64	23 52 15	49	10
	215	44 27 74	·12	·14	09	·04	02	27 65	44 24 93	72	13
	218	52 03 57	·12	11	09	05	02	03 52	52 00 96	56	03

a = ·518 c = ·088

Chronometer correction at 15h 00m = 2s·89 ·015

						s					
						·07					
W	219	15 53 59 59	·13	·24	06	03	02	39 37	15 53 36 75	02 62	13
	505	59 53 07	·13	+·23	05	03	02	53 33	59 50 89	44	05
	221	16 05 48 14	·14	·51	07	01	03	47 66	16 05 45 26	40	09
	222	09 21 00	·13	·07	05	01	02	21 12	09 18 55	57	08
	σ Scorpii	15 23 02	·13	·29	05	00	02	23 37	15 20 87	50	01
	225	17 43 55	·13	·15	05	00	02	43 46	17 41 05	41	08
E	231	37 42 82	·16	−·30	·06	02	02	42 74	37 40 34	40	09
	232	39 39 51	·16	−·40	·06	02	03	39 32	39 36 79	53	04
	ι Scorpii	43 58 25	15	+·41	06	03	03	58 87	43 56 45	42	07
	478	47 44 99	16	11	05	03	02	45 10	47 42 74	56	07
	233	53 09 66	·15	05	05	04	02	09 83	53 07 [illegible]	52	03

a = ·545 c = ·050

Chronometer correction at 16h 20m = 2s·87 ·019

TRANSIT OBSERVATIONS.

Station: FANNING ISLAND Date: June 10th, 1905 Observer: L. W. G. Weld

Change	Star	Transit over mean of threads	Level and collimation equalities per	Azimuth	Collimation	Rate	Observation	Zenith distance at transit	L. A.	Chronometer correction
		h. m. s.	s.	s.	s.	s.	s.	° ′ ″	° ′ ″	h. m. s.
E 458		14 06 01 8	07	20	09	07	02 01 74	14 06 00 6	01 12	10
185		07 46 0.	06	11	08	06	02 16 29	07 4. 86	00 ..	02
186		10 50 06	07	08	08	06	02 59 22	10 58 10	01 12	11
188		12 4. 06	08	48	12	05	03 14 0	12 43 75	00 9.	06
192		25 42 33	07	11	08	04	1. 17 ..	25 41 11	01 03	02
194		36 13 29	07	26	09	02	1. 1. 2.	36 12 10	00 02	00
196		38 00 22	07	08	08	02	02 00 41	37 59 46	00 ..	06
W 21.		15 39 23 11	01	02	08	0.	02 33 0.	15 39 32 03	0 02	01
213		41 16 .	01	10	08	0.	02 16 17	41 15 19	00 08	04
215		44 26 1	01	13	08	05	02 25 08	44 24 03	01 05	04
216		46 09 4	01	00	08	05	02 02 46	46 01 50	01 00	01
218		52 02 1.	01	11	08	06	02 01 08	52 00 85	01 02	01

a = 191 c = 080

Chronometer correction at 15h 00m 1 = 013

W 595		15 59 51 69	01	33	09	03	02	2	15 59 50 80	01 00	1
223		16 13 1. 17	00	12	08	02	02	17	16 13 14 16	01 01	1
7 Scorpii		15 21 41	00	12	09	01	02 21 71		15 20 88	00 83	07
225		17 42 27	01	12	09	01	02 41 92		17 [illegible] 05	00 87	07
596		23 31 49	02	11	09	01	02 31 79		23 [illegible] 72	00 87	03
228		26 06 80	02	[illegible]	09	00	02 06 41		26 [illegible] 8	00 83	07
E 597		31 52 57	05	2	08	00	0. 52 88		31 52 01	00 87	03
231		37 41 [illegible]	06	1	10	01	02 41 30		37 40 35	00 95	05
478		47 13 46	06	16	09	02	0. 13 45		47 12 51	00 91	01
233		53 08 0	06	0 7	08	02	0 08 16		53 07 32	00 84	0.
234		56 38 44	07	42	10	02	1 38 19		56 37 31	00 88	1

a = 187 c = 083

Chronometer correction at 15h 30m 0 = 014

TRANSIT OBSERVATIONS.

Station: FANNING ISLAND. Date, June 15th, 1903. Observer: F. W. O. WERRY.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	r.
		h. m. s.	s.	s.	s.	s. r = +·015	s.		h. m. s.	s.	s.
E	457	13 56 42·37	·05	−·30	+·04	−·02	·02	42·02	13 56 48·62	+06·60	+·09
	π Hydræ	14 00 46·73	−·05	+·36	+·04	−·02	−·02	47·04	14 00 53·67	·63	+·06
	185	07 38·99	−·05	+·16	+·04	−·02	·02	39·10	07 45·77	·67	+·02
	188	12 37·61	−·02	·64	+·06	·02	·03	36·96	12 43·67	·71	·02
	192	27 34·76	+·01	−·34	+·05	−·01	−·02	34·35	27 41·10	·65	+·04
	196	37 52·49	+·03	+·10	+·04	−·01	·02	52·63	37 59·44	·81	·12
	ϵ^2 Bootis	40 40·75	+·03	−·29	+·04	−·01	·02	40·50	40 47·29	·79	·10
W	463	51 34·32	·02	·12	+·04	·00	−·02	34·12	51 40·89	·77	·08
	199	58 13·62	−·02	·51	+·05	·00	·03	13·01	58 19·68	·67	−·02
	465	15 00 13·32	−·02	−·29	+·04	·00	−·02	12·95	15 00 19·63	·68	+·01
	222	16 09 11·84	−·02	+·08	−·04	·00	·02	11·84	16 09 18·57	·73	·04
	223	13 07·57	·02	+·10	−·04	+·01	·02	07·60	13 14·18	·58	+·11
	σ Scorpii	15 13·89	·02	+·35	−·04	+·02	·02	14·18	15 20·90	·72	·03
	225	17 34·65	·02	−·18	·04	+·02	·02	34·41	17 41·05	·64	+·05

$a = +^s·648$ $c = +^s·039$

Chronometer correction at $15^h\ 10^m = +6^s·689 \pm ^s·015$

W	228	16 25 59·25	+·08	−·24	−·09	·01	·02	58·97	16 26 05·59	+06·62	+·10
	τ Scorpii	29 47·01	+·07	+·44	−·10	·01	−·02	47·39	29 54·10	·71	+·01
	597	31 45·31	+·06	+·18	−·09	−·01	−·02	45·43	31 52·03	·60	+·12
	231	37 34·04	+·07	−·46	−·10	−·01	−·02	33·58	37 40·36	·78	−·06
	232	39 30·70	+·07	−·54	−·11	−·01	−·03	30·08	39 36·79	·71	+·01
	ε Scorpii	43 49·26	+·06	+·55	−·10	·00	−·03	49·74	43 56·50	·76	−·04
	30 Ophiuchi	55 52·82	+·06	+·10	−·09	·00	−·02	52·87	55 59·73	·86	−·14
E	237	17 10 09·54	+·09	−·14	+·09	·00	−·02	09·56	17 10 16·20	·64	+·08
	239	11 36·32	+·09	−·50	+·11	·00	−·03	35·99	11 42·76	·77	·05
	σ Ophiuchi	21 38·06	+·09	·00	+·09	+·01	−·02	38·23	21 44·99	·76	−·04
	241	30 21·96	+·09	−·11	+·09	+·01	·02	22·02	30 28·68	·66	+·06
	600	31 57·97	+·09	+·25	+·09	+·01	·02	58·39	32 05·10	·71	+·01
	245	38 36·79	+·09	−·01	+·09	+·01	−·02	36·95	38 43·70	·75	−·03

$a = +^s·735$ $c = +^s·085$

Chronometer correction at $17^h\ 00^m = +6^s·719 \pm ^s·015$

TRANSIT OBSERVATIONS.

Station: FANNING ISLAND. Date, June 21st, 1903. Observer: F. W. O. WERRY.

Champ.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds-corr. transit.	R. A.	Chronometer correction.	c.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	463	14 51 26 16	-·05	·08	·02	·01	·02	26 12	14 51 40 85	-14 73	·06
	465	15 00 05 02	-·05	·20	-·02	·01	·02	04 86	15 00 19 59	·73	-·06
	592	06 29 57	-·05	·18	-·02	·01	·02	29 70	06 44 47	·68	·11
	466	10 09 63	-·05	·01	-·02	·01	·02	09 66	10 24 59	·93	·14
	201	11 23 21	-·05	·26	·02	·00	·03	22 99	11 37 76	·77	-·02
	α^2 Libræ	17 24 99	-·05	-·14	·02	·00	·02	25 18	17 40 06	·88	·09
	202	20 37 30	-·05	·30	-·02	·00	·03	37 04	20 51 77	·73	-·06
	ζ^1 Libræ	22 35 01	-·05	-·16	·02	·00	·02	35 22	22 50 10	·88	·09
W	593	29 54·14	-·02	-·14	·02	·00	·02	54·26	30 08 92	·66	-·13
	469	34 08 44	-·03	·34	·02	-·01	·03	08 09	34 22 92	·83	·04
	211	38 27 91	-·03	·19	·02	-·01	·02	27 72	38 42 59	·87	·08
	213	41 30·47	-·02	·09	·02	-·01	·02	30 37	41 45 17	·80	·01
	594	54 24 03	-·03	-·21	·02	-·02	·02	24·25	54 39 04	·79	·00

a = -·434 c = +·015

Chronometer correction at $15^h\ 20^m$ = -14·792 -·017

W	595	15 59 35 92	-·02	-·18	·03	·02	·02	36 05	15 59 50 92	-14·87	·04
	221	16 05 30 75	-·02	·39	·03	·02	·03	30 39	16 05 45 23	·93	-·10
	222	09 03·75	+·03	+·05	·03	-·02	·02	03 76	09 18 58	·82	-·01
	223	12 59·41	+·03	+·06	-·03	-·02	·02	59 43	13 14 19	·76	-·07
	σ Scorpii.	15 05·82	+·05	+·23	-·03	-·01	-·02	06 04	15 20 91	·87	·04
	225	17 26·50	+·06	-·12	-·03	-·01	·02	26·38	17 41 06	·68	·15
E	232	39 22·19	+·08	-·31	+·04	·00	-·03	21·97	39 36 79	·82	-·01
	479	17 00 40·71	+·08	-·07	+·03	+·01	·02	40 74	17 00 55 59	·85	·02
	480	04 25·01	+·08	-·33	+·04	+·01	·03	24·78	04 39 54	·76	-·07
	239	11 28·15	+·07	·29	+·04	+·02	-·03	27·96	11 42 77	·81	·02
	599	15 51·48	+·07	+·22	+·03	+·02	-·02	51 80	16 06 57	·77	·06
	σ Ophiuchi	21 29·98	+·07	·00	+·03	+·02	·02	30 08	21 45 06	·98	·15
	600	31 50 03	+·07	+·14	+·03	+·02	-·02	50·27	32 05 15	·88	·05

a = +·420 c = +·030

Chronometer correction at $16^h\ 40^m$ = +14·832 -·016

TRANSIT OBSERVATIONS.

Station: FANNING ISLAND. Date, June 23rd, 1903. Observer: F. W. O. WERRY.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of c. e. transit.	R. A.	Chronometer correction.	v.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	192	14 27 23·72	+ ·05	·26	·05	+ ·06 ·09	·02	23·35	14 27 41·01	17·66	+ ·11
	σ^2 Bootis	40 29·74	+ ·04	·22	·05	·08	·02	29·41	40 47 22	·81	·04
	590	45 15·56	·04	+ ·17	·04	·07	·02	15·64	45 33 46	·82	·05
	25	16 17 23·15	·04	·14	·04	+ ·02	·02	23·31	16 17 41 06	·75	+ ·02
	173	20 41·38	+ ·05	·09	·04	+ ·02	·02	41·30	20 59 12	·82	·05
	596	23 12·91	·04	·28	·04	+ ·02	·02	13·19	23 30 97	·78	·04
W	τ Scorpii	29 36·03	+ ·10	+ ·30	+ ·05	+ ·03	·02	36·39	29 54 13	·74	+ ·03
	597	31 34·25	·00	+ ·12	+ ·04	+ ·03	·02	34·42	31 52 06	·64	·13
	231	37 22·69	+ ·01	·27	+ ·05	+ ·04	·02	22·50	37 40 35	·85	·08
	232	39 19·22	·02	·37	+ ·05	+ ·04	·03	18·93	39 36 78	·85	·08
	ϵ Scorpii	43 38·20	+ ·02	+ ·37	+ ·05	+ ·04	·03	38·65	43 56 54	·89	·12
	233	52 49·73	·02	·05	+ ·04	+ ·05	·02	49·77	53 07 38	·61	·16

$a = + {}^{s}\cdot501$ $c = - {}^{s}\cdot041$

Chronometer correction at $16^h\ 00^m\ 00^s = + 17^s\cdot767 \pm \cdot019$

TRANSIT OBSERVATIONS.

Station: FANNING ISLAND. Date, June 24th, 1903. Observer: F. W. O. WERRY.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	v.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
W	205	15 23 32·84	·02	·22	·09	·04	·02	32·57	15 23 52·07	19·50	·03
	206	27 09·74	·02	·35	·11	·03	·03	09·30	27 28·91	·61	·08
	593	29 49·39	·02	·14	·08	·03	·02	49·48	30 08·91	·43	·10
	469	34 03·83	·02	·34	·11	·02	·03	03·39	34 22·89	·50	·03
	211	38 25·24	·02	·18	·09	·02	·02	22·99	38 42·59	·60	·07
E	218	51 41·44	·09	·09	·09	·00	·02	41·51	52 00·93	·42	·11
	595	59 31·04	·09	·18	·09	·01	·02	31·37	59 50·92	·55	·02
	222	16 08 58·79	·09	·06	·08	·02	·02	58·98	16 09 18·57	·59	·06
	σ Scorpii	15 00·98	·09	·23	·09	·03	·02	01·34	15 20·92	·58	·05
	225	17 21·55	·09	·12	·09	·03	·02	21·56	17 41·06	·50	·03

a = ·430 c = ·082

Chronometer correction at 15h 50m = 19s·530 ± ·018

E	473	16 20 39·49	·07	·09	·14	·05	·02	39·64	16 20 59·11	19·47	·04
	τ Scorpii	29 34·17	·06	·29	·16	·04	·02	34·70	29 54·13	·43	·00
	597	31 32·39	·05	·12	·14	·04	·02	32·72	31 52·06	·34	·09
	232	39 17·45	·07	·36	·18	·03	·03	17·34	39 36·78	·44	·01
	ε Scorpii	43 36·49	·07	·36	·17	·02	·03	37·08	43 56·54	·46	·03
	478	47 23·09	·07	·10	·15	·02	·02	23·21	47 42·59	·38	·05
	233	52 47·73	·07	·05	·14	·01	·02	47·88	53 07·38	·50	·07
W	234	56 18·39	·03	·26	·16	·01	·02	17·99	56 37·33	·34	·09
	599	17 15 47·23	·02	·26	·15	·02	·02	47·32	17 16 06·59	·27	·16
	σ Ophiuchi	21 25·67	·03	·00	·14	·03	·02	25·51	21 45·05	·54	·11
	241	30 09·56	·02	·07	·14	·04	·02	09·31	30 28·73	·42	·01
	600	31 45·69	·02	·16	·15	·04	·02	45·66	32 05·18	·52	·09
	245	38 24·42	·03	·00	·14	·05	·02	24·24	38 43·77	·53	·10

a = +·485 c = +·140

Chronometer correction at 17h 00m = 19s·433 ± ·017

TRANSIT OBSERVATIONS.

Station: SUVA. Date, June 3rd, 1903. Observer, OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr transit.	R. A	Chronometer correction	r.
		h. m. s.	s.	s.	s.	s. r = − ·15	s.		h. m. s.	m s.	s.
E	β Chamæleontis	12 16 25 58	− ·19	10·62	− ·96	+ ·11	·10	13·82	12 12 45·92	− 3 27·90	·02
	δ² Corvi... ..	28 20 92	·08	+ ·10	− ·20	+ ·08	·02	20·80	24 52 88	·92	·00
	ρ Virginis....	40 27 45	·07	+ 1·16	− ·19	+ ·05	− ·02	28·38	36 50·46	·92	·00
	35 Virginis. ..	46 24·41	·07	+ ·90	− ·19	+ ·04	·02	25 07	42 57·10	·97	− ·05
	31 Comæ.. ..	50 26 52	·06	+ 1·85	− ·21	+ ·03	·02	28·11	46 60·31	·80	·12
	δ Virginis ...	54 12·39	− ·07	+ ·90	− ·19	+ ·02	− ·02	13·03	50 45·11	·92	·00
	ε Virginis.. ..	13 00 49 94	− ·07	+ 1·19	− ·19	·00	− ·02	50·85	57 22 94	·91	·10
W	γ Hydræ.. ..	17 09·59	− ·17	− ·21	+ ·20	− ·04	− ·02	09·35	13 13 41·45	·90	·02
	ι Centauri.. ..	18 40·28	− ·19	− ·90	+ ·23	− ·04	− ·02	39 36	15 11·47	·89	·03
	α Virginis.	23 35·05	− ·16	+ ·31	+ ·19	− ·05	− ·02	35·32	20 07·36	·96	− ·04
	ζ Virginis. .	33 14·67	− ·15	+ ·74	+ ·19	− ·08	·02	15 35	29 47·32	28·03	− ·11
	ε Centauri.....	37 18 29	− ·21	− 2·16	+ ·30	− ·09	− ·03	16 10	33 48 30	27 80	·12
	m Virginis....	40 01·37	− ·16	+ ·40	+ ·19	− ·10	·02	01·68	36 33·67	28·01	− ·09
	τ Boötis. ...	46 07 89	− ·14	+ 1·47	+ ·20	− ·11	− ·02	09 29	42 41·33	27 96	+ ·04

a = − 2ˢ·376 c = − ˢ·188

Chronometer correction at 13ʰ 1ᵐ 3ᵐ 27ˢ·921 ·013

TRANSIT OBSERVATIONS.

Station: SUVA. Date, June 4th, 1903. Observer: OTTO KLOTZ

Clamp	Star	Transit over mean of threads	Level and inequality of pivots	Azimuth	Collimation	Rate	Aberration	Seconds of corr. transit	R A	Chronometer correction	
		h m s	s.	s.	s.	s.	s.		h m s	m. s.	s.
E	ε Virginis	13 00 51 52	01	-2 50	21	10	02	53 88	12 57 22 93	3 30 95	-06
	θ Virginis	08 27 89	01	1 15	21	09	02	28 89	13 04 57 87	31 02	01
	γ Hydræ	17 13 06	01	45	22	06	02	12 42	13 41 44	30 98	03
	ι Centauri	18 44·67	01	1 90	26	05	02	42 53	15 11 46	31 07	-06
	ζ Virginis	33 16·93	01	-1 55	21	01	02	18 25	29 47 31	30 94	07
	ε Centauri	37 24 30	01	4 54	33	00	03	19 39	33 48 28	31 11	-10
	m Virginis	40 04 03	01	-85	21	01	02	04 63	36 33 66	30 97	04
W	τ Bootis	46 09 17	00	3 10	22	03	02	12 44	42 41 32	31 12	11
	ζ Centauri	53 07 07	-00	3 50	30	05	03	03 79	49 32 87	30 92	09
	τ Virginis	14 00 14·20	00	-1 70	21	07	02	16 02	56 44 98	31 04	-03
	π Hydræ	04 25·35	00	75	23	08	02	24 73	14 00 53 74	30 99	02
	κ Virginis	11 16·10	-00	75	21	10	02	16 94	07 45 85	31 09	-08
	α Bootis	14 44 06	00	-3 25	22	10	02	47 41	11 16 43	30 98	03

a -5s·011 c -209

Chronometer correction at 13h 37m 3m 31s·014 -014

W	β Libræ	15 15 20 36	-03	80	-18	13	02	21 48	15 11 49 99	3 31 49	-13
	α¹ Libræ	26 21·09	-03	15	19	-09	02	21 53	22 50 10	43	-07
	γ Lupi	32 17·85	-03	2 56	23	-08	03	15·60	28 44 37	23	13
	α Coronæ	34 04·39	-02	-3 97	-20	-07	02	08 63	30 37·31	32	04
	α Serpentis	43 01 08	-02	-2 11	-18	-05	02	03 42	39 32·05	37	-01
	α Serpentis	48 06 12	-02	-1 41	18	+03	02	07 74	44 36 24	-0	14
	β Triang. Aust.	50 20·18	-04	7 73	-39	-03	04	12 87	46 41·56	31	-05
E	δ Scorpii	58 10·82	+09	-46	-19	-01	02	10 31	54 39 02	29	07
	β¹ Scorpii	16 03 22·51	-09	15	-19	-01	02	22·23	59 50·87	36	00
	γ² Normæ	16 14 88	+11	4·07	28	03	03	10 58	16 12 39 19	39	-03
	γ Herculis	21 09·28	-07	-3·26	19	06	02	12 34	17 41 05	29	07
	α Scorpii	27 03·17	-09	80	20	-08	02	02·16	23 30 90	26	10
	λ Ophiuchi	29 33.83	-08	-1·76	18	-08	02	35·39	26 04 01	38	02
	α Triang. Aust.	42 13·38	-15	-10·75	49	12	06	02 11	38 30 67	44	-08

a 5s·022 c -178

Chronometer correction at 16h 00m -3m 31s·361 -014

TRANSIT OBSERVATIONS.

Station : Suva. Date, June 9th, 1903. Observer : Otto Klotz.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	c.
		h. m. s.	s.	s.	s.	s. r −·12	s.		h. m. s.	m. s.	s.
E	γ Crucis.....	12 29 34·71	−·06	−·75	·34	+·09	·04	35·23	12 25 50·20	3 45·03	−·06
	ζ Corvi.....	33 04·73	−·06	−·06	−·21	−·08	·02	04·70	29 19·71	44·99	−·02
	ρ Virginis.....	40 45·83	+·06	·32	−·19	−·07	·02	45·43	37 00·40	45·03	−·06
	ζ Crucis.....	45 50·97	+·13	+·85	·37	+·06	·04	51·60	42 06·70	44·90	·07
	δ Virginis.....	54 30·24	−·11	·25	·19	−·04	·02	29·93	50 45·06	44·87	·10
	ε Virginis.....	13 01 08·23	−·12	·33	·19	−·03	·02	07·84	57 22·89	44·95	·02
	θ Virginis.....	08 43·04	+·15	·15	·19	−·01	·02	42·84	13 04 57·83	45·01	−·04
W	γ Hydræ.....	17 26·05	−·11	+·08	−·21	·01	·02	26·42	13 41·40	45·02	−·05
	α Virginis.....	23 52·21	−·10	·11	−·19	·02	·02	52·35	20 07·32	45·03	−·06
	ζ Virginis.....	33 32·36	+·10	·27	−·19	·04	·02	32·32	29 17·28	45·04	+·07
	ε Centauri.....	37 32·08	−·13	+·78	−·30	·05	·03	33·21	33 48·21	45·00	−·03
	τ Virginis.....	14 00 30·06	−·09	·29	−·19	·09	·02	29·94	36 44·95	44·99	−·02
	π Hydræ.....	04 38·31	−·11	+·13	−·21	·10	·02	28·64	14 00 53·72	44·92	·05
	κ Virginis.....	11 30·74	−·10	·13	−·19	·12	·02	30·76	07 45·83	44·93	·04

a_2 +·855 a_1 +·663 c −·190

Chronometer correction at 13h 14m 3m 44s·971 +·014

W	β Libræ.....	15 15 35·10	·11	·12	−·14	+·19	·02	35·40	15 11 50·00	−3 45·40	+·01
	ζ¹ Libræ.....	26 35·25	+·11	·02	+·14	+·17	·02	35·63	22 50·11	·52	−·13
	γ Lupi.....	32 28·86	+·14	+·39	+·18	+·16	−·03	29·70	28 44·39	·31	·08
	ζ¹ Scorpii.....	16 03 35·85	−·12	+·02	+·15	+·09	·02	36·21	39 50·90	·31	·08
	δ Ophiuchi.....	13 03·79	−·11	·19	+·14	+·07	·02	03·90	16 09 18·56	·34	−·05
	γ² Normæ.....	16 23·66	+·14	+·63	−·21	+·07	·03	24·68	12 39·24	·44	+·05
E	λ Scorpii.....	17 30 50·00	+·41	+·32	·17	·08	·03	50·45	17 27 05·06	·39	·00
	η Pavonis.....	40 02·93	+·56	+1·31	·32	·10	·05	04·33	36 18·95	·38	·01
	ζ Ophiuchi.....	42 29·33	+·30	−·30	·14	·10	·02	29·07	38 43·66	·41	−·02
	μ Herculis.....	46 28·40	−·28	·63	·15	·11	−·02	27·77	42 42·38	·39	·00
	89 Herculis.....	55 19·10	−·28	·60	·15	·13	·02	18·48	51 33·10	·38	·01
	ν Ophiuchi.....	57 29·69	−·35	·12	·14	·14	·02	29·62	53 44·19	·43	−·04

a +·777 c −·140

Chronometer correction at 16h 50m 3m 45s·392 +·013

TRANSIT OBSERVATIONS.

Station: SUVA. Date, June 10th, 1903. Observer: OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
E	β Chamæleontis	12 16 30 44	-·40	-2·76	1·02	·11	10 32 59		12 12 45 31	3 47 28	·02
	β Corvi	33 06 89	+·17	-·06	·22	·07	02 06 95		29 19 70	·25	·01
	μ Virginis	40 48 00	-·14	·30	·20	·05	·02 47 67		37 00 39	·28	·02
	35 Virginis	46 44 55	-·15	·23	·20	·04	02 44·29		42 57 03	·26	·00
	31 Comæ	50 48 14	·13	-·48	·23	·02	02 47 56		46 60 23	·33	·07
	δ Virginis	54 32 51	·15	·23	·20	·01	02 32 22		50 45 04	·18	·08
	ε Virginis	13 01 10·47	-·14	-·31	-·20	·00	02 10 08		57 22 88	·20	·06
W	θ Virginis	08 44 98	·16	·14	-·20	·02	02 45 16		13 04 57 82	·34	·08
	γ Hydræ	17 28 27	·17	·06	-·21	·04	02 28 65		13 41 39	·26	·00
	ι Centauri	18 57 96	·19	·23	-·25	·05	02 58 56		15 11 40	·16	·10
	α Virginis	23 54 42	·16	·08	-·20	·06	02 54 62		20 07 31	·31	·05
	ζ Virginis	33 34 55	·15	·19	-·20	·08	02 34 61		29 47 27	·34	·08
	m Virginis	40 20 74	-·16	·10	-·20	·10	02 20 88		36 33 63	·25	·01
	τ Bootis	46 28 69	-·14	·38	-·20	·11	02 28 52		42 41 27	·25	·01

a = +·618 c = -·198

Chronometer correction at 13h 00m 3m 47s·263 +·011

W	ρ Bootis	14 31 29 05	·05	·74	-·27	·10	·03 28·70		14 27 41 16	3 47 5·[illegible]	
	e^2 Bootis	44 35·12	·06	·56	-·24	-·07	·02 34 91		40 47·33	·54	·02
	α Libræ	49 20 86	-·07	·03	-·22	-·06	02 21·16		45 33 55	·67	·05
	s^2 Libræ	55 20 46	-·07	·09	+·21	-·04	02 20 67		51 33 03	·61	·08
	20 Libræ	15 02 13·71	+·08	+·09	+·23	-·03	02 14 12		58 26 67	·44	·11
E	β Libræ	15 37·57	+·29	·11	·21	·01	02 37 51		15 11 50 00	·51	·05
	α Coronæ	34 25 49	-·23	·55	-·23	·05	·02 24 87		30 37 30	·57	·01
	α Serpentis	43 19 95	+·26	·29	·21	·07	·02 19 62		39 32 07	·55	·01
	α Serpentis	48 24 01	+·28	·19	·21	·09	02 [illegible] 78		44 36 27	·51	·05
	ε Serpentis	49 49 42	+·28	·16	-·21	·09	02 49 22		46 01 53	·69	·13
	γ Serpentis	55 48·97	+·25	·40	·22	·10	02 48 48		51 60 95	·53	·03

a = +·692 c = -·209

Chronometer correction at 15h 13m 3m 47s·561 +·020

TRANSIT OBSERVATIONS.

Station: SUVA — Date, June 11th, 1903. — Observer: OTTO KLOTZ

Clamp	Star.	Transit over mean of threads.	Level and inequality of pivots	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr transit.	R. A.	Chronometer correction.	r
		h m s	s.	s.	s	s.	s.		h m s.	m. s.	s.
						.14					
E	β Chamæleontis	12 16 33 49	·03	- 2·79	1·24	- ·15	10 35 06		12 12 45 22	3 49 84	- ·06
	δ^2 Corvi. . .	28 42·66	- ·17	·02	·25	- ·12	02 42 66		24 52 79	·87	- ·09
	ε Virginis. .	13 01 13 06	- ·15	·31	·25	- ·05	02 12 68		57 22 87	·81	- ·03
	α Virginis.	23 57 23	·17	·08	·25	- ·02	02 57·07		13 29 07 31	·76	·02
	ε Centauri. .	37 37·50	·22	- ·57	- ·39	·03	03 37 84		33 48 18	·66	·12
	μ Virginis .	40 23 57	- ·17	·11	·24	·04	02 23 33		36 33 62	·71	·07
	τ Bootis. .	46 31 57	- ·14	·39	·25	·06	02 30 99		42 41 27	·72	·06
W	ζ Centauri. .	53 21 72	- ·10	- ·44	+ ·35	·07	03 22 51		49 32 80	·71	·07
	τ Virginis. ..	14 00 34 80	- ·08	·21	+ ·21	·09	02 34 80		56 44·94	·86	- ·08
	θ Centauri. .	04 50 80	- ·09	+ ·24	+ ·30	·10	02 51 31		14 01 01 54	·77	·01
	κ Virginis.	11 35 56	- ·08	·09	+ ·24	·12	02 35 65		07 45 82	·83	- ·05
	α Bootis.... .	15 06 38	- ·07	·41	+ ·26	·13	02 06 15		11 16 39	·76	·02
	ζ Bootis.. . .	25 49 02	·07	·41	- ·26	·15	02 48 77		21 58 90	·87	- ·09

a = - ·624 c = ·242

Chronometer correction at $13^h\ 21^m$ $3^m\ 49^s\ 782$ - ·015

W	ξ^2 Libræ.	14 55 22 72	·25	·09	·19	- ·12	02 23 17		14 51 33 03	3 50 14	·05
	20 Libræ...	15 02 16 04	·27	- ·09	- ·21	- ·10	·02 16 69		58 26 67	·02	·07
	ψ Bootis	04 09 83	- ·20	- ·58	+ ·21	- ·10	02 09·74		15 00 19 69	·05	·04
	ι^1 Libræ.	10 34 00	- ·26	+ ·01	+ ·20	- ·08	02 34·53		06 44 50	·03	·06
	α^2 Libræ. .	21 29 82	- ·26	·04	- ·20	- ·06	02 30 28		17 40·08	·20	- ·11
	ζ^1 Libræ.	26 39 74	- ·26	·02	+ ·20	- ·05	·02 40 21		22 50 13	·08	·01
E	α Coronæ.. . ..	34 27 83	- ·32	·57	·21	- ·03	02 27 38		30 37 30	·08	·01
	α Serpentis....	43 22·28	- ·38	·30	·19	·00	·02 22 15		39 32 07	·08	·01
	β Triang. Aust.	50 30 38	- ·66	+ 1·11	·42	·01	·04 31 68		46 41 59	·09	·00
	β^1 Scorpii. .. .	16 03 40 84	- ·43	- ·02	·20	·04	02 41 03		59 50 91	·12	·03
	δ Ophiuchi.....	13 08 77	- ·40	·18	·19	·06	02 08 72		16 09 18 60	·12	- ·03
	λ Ophiuchi.....	29 54 35	- ·39	·25	·19	·10	·02 54 18		26 04 08	·10	·01
	ζ Ophiuchi.....	35 42·15	- ·41	- ·10	·19	·12	·02 42 13		31 52 04	·09	·00

a = + ·721 c = ·191

Chronometer correction at $15^h\ 45^m$ $3^m\ 50^s\ 090$ - ·010

TRANSIT OBSERVATIONS.

Station: SUVA

Date, June 16th, 1903.

Observer: Otto Kloiz

Clamp.	Star	Transit over mean of threads	Level and azimuth pivots	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of over transit	R A	Chronometer correction	
		h m s	s.	s.	s.	s.	s.		h m s	m. s.	s.
E	κ Virginis.	14 11 48 37	04	08	17	05	02 48 19		14 07 45 82	4 02 37	09
	α Bootis	15 19 27	07	36	18	05	02 18 83		11 16 35	48	02
	ζ Bootis	26 01 82	08	36	18	03	02 01 37		21 58 88	49	03
	η Centauri	33 26 55	07	60	22	02	03 43 49		27 41 11	38	08
	α Cincini	38 47 14	10	41	23	02	03 26 82		29 24 40	42	04
	e^2 Bootis	44 50 39	09	45	19	00	02 49 82		40 47 28	54	08
W	α Libræ.	49 35 88	01	02	17	01	02 35 99		45 33 53	46	00
	σ^2 Libræ.	55 35 51	01	07	17	02	02 35 56		51 33 02	54	08
	20 Libræ	15 02 28 83	01	07	18	03	02 29 02		58 26 65	37	09
	ζ Bootis	04 22 43	01	45	19	04	02 22 10		15 00 19 66	44	02
	γ Triang. Aust.	13 58 45	02	1 21	48	05	06 60 01		09 57 58	43	03
	β Libræ.	15 52 56	01	09	17	05	02 52 56		11 49 99	57	11

a = +·569 c = +·170

Chronometer correction at 14h 43m 4m 02s 461 + 014

Clamp.	Star	Transit over mean of threads	Level and azimuth pivots	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of over transit	R A	Chronometer correction	
W	α Serpentis	15 43 34 77	03	26	20	06	02 34 78		15 39 32 07	4 02 71	11
	μ Serpentis.	48 38 86	03	17	20	06	02 38 96		44 36 28	68	08
	β Triang. Aust.	50 42 63	05	95	43	05	04 44 07		46 41 57	50	10
	γ Serpentis.	56 03 70	03	36	20	04	02 03 59		52 00 95	64	04
	δ Scorpii	58 41 37	03	05	21	04	02 41 68		54 39 07	61	01
	β^1 Scorpii	16 03 53 35	03	02	21	03	02 53 62		59 50 92	70	10
	δ Ophiuchi	13 21 09	03	15	20	01	02 21 16		16 09 18 61	55	05
E	γ Herculis	21 44 09	26	40	21	00	02 43 72		17 41 08	64	04
	α Scorpii	27 33 33	34	16	22	01	02 33 52		23 30 99	53	07
	α Triang. Aust.	42 32 29	54	1 32	54	03	06 33 52		38 30 82	70	10
	ε Scorpii	47 58 81	36	20	24	04	02 59 07		43 56 50	57	03
	κ Ophiuchi	57 10 32	25	38	20	06	02 09 91		53 07 40	51	09
	30 Ophiuchi	17 00 02 40	36	16	20	06	02 02 26		55 59 73	53	07

a = +·617 c = ·195

Chronometer correction at 16h 22m 4m 02s 605 + ·016

TRANSIT OBSERVATIONS.

Station: SUVA. Date, June 22nd, 1903. Observer: OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	c.
		h. m. s.	s.	s.	s.	s. r − 10	s.		h. m. s.	m. s.	s.
E	γ Hydræ	13 17 57 02	+ ·04	+ ·04	·20	+ ·08	·02	57 56	13 13 41 27	4 16 29	+ ·04
	ι Centauri	19 27 45	+ ·04	+ ·21	·23	+ ·07	·02	27 52	15 11 25	27	+ ·02
	α Virginis	24 23 69	+ ·04	·07	·19	+ ·06	·02	23 51	20 07 20	31	+ ·06
	ζ Virginis	34 03 73	+ ·04	·17	·19	+ ·05	·02	03 44	29 47 16	28	+ ·03
	ε Centauri	38 03 97	+ ·05	+ ·49	·30	+ ·04	·03	04 22	33 47 09	23	·02
	τ Bootis	46 57 90	+ ·03	·34	·20	+ ·03	·02	57 40	42 41 16	·24	·01
	η Bootis	54 22 70	+ ·03	·35	− ·20	+ ·02	·02	22 18	50 06 01	·17	·08
W	β Centauri	14 01 18 23	− ·08	+ ·71	+ ·38	·00	·04	19 20	57 02 99	·21	·04
	π Hydræ	05 09 64	·06	+ ·08	− ·21	·00	·02	09 85	14 00 53 62	·23	·02
	κ Virginis	12 02 02	·06	·08	+ ·19	·02	·02	02 03	07 45 76	·27	+ ·02
	ζ Bootis	26 15 38	·05	·35	+ ·20	·04	·02	15 10	21 58 83	·27	+ ·02
	μ Bootis	31 57 69	·04	·58	+ ·24	·05	·03	57 23	27 11 04	·19	·06
	ϵ^2 Bootis	45 03 83	·04	·44	+ ·21	·07	·02	03 47	40 47 22	·25	·00
	α Libræ	49 49 81	·06	·02	·20	·08	·02	49 83	45 33 49	·34	·09

$a = +\cdot 542$ $c = +\cdot 189$

Chronometer correction at $14^h\ 03^m$ $4^m\ 16^s\cdot 254 + \cdot\cdot 000$

TRANSIT OBSERVATIONS.

Station: Sova. Date, June 24th, 1903. Observer: Otto Klotz

Clamp.	Star.	Transit over mean of threads.	Level east minus west.	Azimuth.	Collim. error.	Rate.	Variation of rate.	Zenith tel. error.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
E	31 Comæ	12 51 21 14	·12	·50	·21	·07	·02	20 60	12 46 60 04	4 20 56	·16
	δ Virginis	55 05 62	·14	·24	·19	·06	·02	05 37	50 44 90	47	·03
	ε Virginis	13 01 43 57	·13	·32	·19	·05	·02	43 22	57 22 73	49	·01
	θ Virginis	09 18 34	·14	·15	·19	·04	·02	18 16	13 04 57 65	47	·03
	γ Hydræ	18 01 68	·16	·06	·20	·02	·02	01 70	13 41 25	45	·05
	ι Centauri	19 31 63	·17	·24	·23	·02	·02	31 81	15 11 22	59	·01
	α Virginis	24 27 80	·15	·08	·19	·01	·02	27 67	20 07 18	49	·01
W	ζ Virginis	34 07 77	·01	·20	·19	·01	·02	07 72	29 47 15	57	·07
	ι Centauri	38 07 58	·01	·59	·30	·02	·03	08 41	33 47 95	46	·04
	m Virginis	40 53 99	·01	·11	·19	·02	·02	54 02	36 33 52	50	·00
	τ Bootis	47 01 84	·01	·40	·26	·04	·02	01 57	42 41 13	44	·08
	ζ Centauri	53 52 51	·01	·45	·27	·05	·03	53 14	49 32 62	52	·02
	τ Virginis	14 01 05 49	·01	·22	·19	·06	·02	05 37	56 44 85	52	·02
	π Hydræ	05 13 85	·01	·10	·21	·07	·02	14 06	14 00 53 60	46	·04

a = ·643 c = ·187

Chronometer correction at 13h 28m 4m 20s.501 ·009

W	α Bootis	14 15 37 02	·03	·33	·20	·00	·02	36 99	14 11 16 27	4 20 72	·03
	ζ Bootis	26 19 66	·03	·33	·20	·07	·02	19 55	21 58 81	74	·05
	ρ Bootis	32 01 86	·02	·54	·24	·06	·03	01 61	27 41 02	59	·10
	α Circini	39 04 56	·05	·85	·44	·04	·02	05 92	34 45 19	73	·04
	e^2 Bootis	45 07 99	·02	·41	·21	·03	·02	07 82	40 47 21	61	·08
	α Libræ	49 53 98	·03	·02	·20	·02	·02	54 19	45 33 49	70	·01
E	S^2 Libræ	55 53 79	·21	·07	·19	·01	·02	53 75	51 32 98	75	·06
	20 Libræ	15 02 47 26	·23	·07	·21	·00	·02	47 33	58 26 62	71	·02
	ψ Bootis	04 40 81	·17	·41	·21	·01	·02	40 33	15 00 19 66	73	·04
	d^1 Libræ	11 05 13	·22	·01	·20	·02	·02	05 12	06 44 47	65	·04
	δ Libræ	16 10 83	·21	·08	·19	·03	·02	10 72	11 49 96	76	·07
	δ Triang. Aust.	51 01 57	·34	·78	·42	·10	·04	02 13	46 41 53	60	·09

a = ·506 c = ·189

Chronometer correction at 15h 00m 4m 20s.691 ·013

TRANSIT OBSERVATIONS.

Station: SIVA. Date, June 25th, 1903. Observer: OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads	Level and in equatorial intervals	Azimuth.	Collimation	Rate.	Aberration	Nutation	R. A.	Chronometer correction
		h m s	s	s	s	s	s	s	h m s	h m s
E	ζ Virginis	13 34 10 27	07	14	16	08	02	10 10	13 29 47 14	4 22 96 04
	ε Centauri	38 19 03	10	41	26	07	02	10 92	33 47 93	99 04
	ω Virginis	46 56 54	07	07	16	06	[illegible]	56 42	36 33 51	91 04
	τ Bootis	47 04 50	06	27	17	05	[illegible]	04 15	42 41 13	[illegible] 02 07
	ε Centauri	53 55 34	09	32	24	04	[illegible]	55 5[illegible]	49 32 61	[illegible] 92 03
	γ Virginis	14 01 08 03	07	15	16	02	02	07 79	56 44 84	95 [illegible]
	π Hydræ	05 16 54	08	08	18	01	02	16 51	[illegible] 00 53 59	92 [illegible]
W	κ Virginis	12 08 03	03	08	16	00	02	08 66	07 45 72	[illegible] 01
	α Bootis	15 39 41	02	30	17	01	02	39 23	11 [illegible] 25	[illegible] 01
	ζ Bootis	26 21 99	02	30	17	03	02	21 79	21 [illegible] 80	[illegible] 04
	ρ Bootis	32 04 29	02	47	20	04	03	03 93	27 41 01	92 03
	ϵ^2 Bootis	45 10 45	02	37	18	07	02	9 15	40 47 19	[illegible] 01
	α Libræ	49 56 41	03	02	17	07	02	44	45 33 48	[illegible] 01

a 156 c ·159

Chronometer correction at 14h 12m 4m 22s 952 ·008

W	β^2 Libræ	14 55 55 93	01	07	20	11	02	56 14	14 51 32 98	4 23 16	00
	20 Libræ	15 02 49 38	01	07	21	10	02	49 73	58 26 61	12	04
	ψ Bootis	04 42 85	01	44	22	10	02	42 70	15 00 19 59	11	05
	d^1 Libræ	11 07 36	01	01	20	08	02	07 62	06 44 46	16	00
	3 Libræ	16 13 02	01	09	19	07	02	13 16	11 49 95	21	05
	c^1 Libræ	27 13 08	01	02	20	05	02	13 28	22 50 09	19	03
E	δ Triang. Aust.	51 03 96	28	84	43	00	04	04 61	46 41 51	10	06
	δ Scorpii.	59 02 26	19	05	21	01	02	02 26	54 39 07	19	03
	β^1 Scorpii.	16 04 14 25	19	02	20	02	02	14 22	59 50 93	29	13
	α Scorpii.	27 54 12	19	09	21	07	02	54 10	16 23 31 01	09	07
	λ Ophiuchi	30 27 57	17	19	19	08	02	27 26	26 04 10	16	00
	ζ Ophiuchi.	36 15 50	18	08	20	09	02	15 29	31 52 08	21	05
	ε Scorpii.	48 19 63	20	18	23	11	02	19 65	43 56 54	11	05

a ·548 c ·192

Chronometer correction at 15h 52m 4m 23s 162 ·013

TRANSIT OBSERVATIONS.

Station - SEAY. Date, August 11th, 1903. Observer - Otto Klotz.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth	Collimation	Rate.	Aberration	Seconds of corr. transit.	R. A.	Chronometer correction.
		h m s	s.	s.	s.	s.	s.		h m s	s.
E	η Ophiuchi	17 05 13 94	-14	02	25	-004 -06	02	13 87	17 04 51 94	-21 93
	β Herculis	11 27 55	-11	37	24	-05	03	25 08	11 05 23	85
	3 Aræ	17 40 55	-19	-52	20	-04	04	40 87	17 18 98	89
	σ Ophiuchi	22 07 02	12	-19	22	-04	02	06 75	21 44 87	88
	λ Scorpii	27 26 89	-16	-20	22	-03	03	26 57	27 05 09	88
	α Ophiuchi	30 50 42	-11	25	23	-02	02	50 45	30 28 00	85
	η Pavonis	36 40 00	-13	-83	32	01	05	40 49	36 18 09	80
W	89 Herculis	51 55 03	04	-38	25	01	-02	54 83	51 33 04	79
	ν Ophiuchi	54 06 18	-05	07	22	02	02	06 24	53 11 [illegible]	80
	γ Sagittarii	59 59 96	06	-12	26	03	-02	00 23	59 38 [illegible]	80
	72 Ophiuchi	18 03 09 96	04	-23	22	03	02	09 80	18 02 47 93	86
	α Sagittarii	08 23 00	05	-02	23	04	03	23 13	08 01 21	87
	η Serpentis	16 42 33	04	13	32	05	03	42 30	16 20 53	92
	α Telescopii	20 12 00	06	-33	32	-06	-02	13 11	19 51 30	81

a = -·389 c = -·222

Chronometer correction at 17h 43m = 21·863 ± ·011

TRANSIT OBSERVATIONS.

Station: SUVA. Date, August 14th, 1903. Observer: OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R.A.	Chronometer correction.	σ.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	ϵ Herculis	16 57 03·70	·09	·49	·21	+ ·07	·02	02·96	16 56 36·85	26·11	·06
	δ Herculis	17 11 32·00	·09	·42	·20	+ ·06	·02	31·33	17 11 05·18	·15	·02
	ζ Ara	17 44·96	·16	+ ·59	·31	+ ·05	·04	45·09	17 18·91	18	+ ·01
W	η Serpentis	18 16 46·95	·15	·15	+ ·18	·03	·02	46·78	18 16 20·50	·28	+ ·11
	α Telescopii	29 17·07	·20	+ ·38	+ ·26	·04	·03	17·44	19 51·26	·18	+ ·01
	λ Sagittarii	22 28·87	·17	·08	+ ·20	·04	·02	28·92	22 02·65	·27	+ ·10
	α Lyræ	34 08·70	·11	·60	+ ·23	·05	·03	08·14	33 42·01	·13	·04
	ζ Aquilæ	37 27·59	·16	·09	+ ·18	·06	·02	27·24	37 01·08	·16	·01
	λ Pavonis	43 44·96	·25	+ ·84	+ ·38	·07	·04	45·82	43 19·72	·10	·07
	σ Sagittarii	49 44·95	·18	+ ·09	+ ·20	·07	·02	44·97	49 18·72	·25	+ ·08

a = + ·560 c = + ·178

Chronometer correction at 17h 53m 26s·173 ±·017.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R.A.	Chronometer correction.	σ.
W	γ Aquilæ	19 42 08·67	+ ·04	·28	+ ·16	+ ·08	·02	08·65	19 41 42·14	26·51	·07
	α Aquilæ	46 32·77	+ ·03	·34	+ ·16	+ ·07	·02	32·67	46 06·34	·33	·11
	ϵ Sagittarii	49 04·35	+ ·05	+ ·30	+ ·22	+ ·07	·03	04·96	48 38·45	·51	+ ·07
	α Pavonis	20 18 29·08	+ ·06	·65	+ ·30	+ ·03	·04	30·08	20 18 03·69	·39	·05
	ρ Capricorni	23 49·66	+ ·04	·00	+ ·17	+ ·02	·02	49·87	23 23·33	·54	+ ·10
	ϵ Delphini	29 04·57	+ ·04	·28	+ ·16	+ ·01	·02	04·48	28 38·09	·39	·05
	α Delphini	35 37·89	+ ·03	·32	+ ·17	+ ·01	·02	37·76	35 11·33	·43	·01
E	ϵ Aquarii	42 55·53	+ ·31	·08	+ ·16	·00	·02	55·58	42 29·03	·55	+ ·11
	μ Aquarii	47 55·26	+ ·31	·08	·16	·01	·02	55·30	47 28·85	45	+ ·01
	ι Piscis Aust.	55 50·52	+ ·36	+ ·17	·19	·02	·02	50·82	55 24·46	36	·08
	α Equulei	21 11 28·57	+ ·29	·22	·16	·04	·02	28·42	21 11 01·95	47	+ ·03
	ζ Capricorni	21 37·75	+ ·31	+ ·05	·18	·05	·02	37·89	21 11·45	44	·00
	ϵ Pegasi	39 55·37	+ ·28	·27	·16	·08	·02	55·12	39 28·75	37	·07

a = + ·564 c = + ·161

Chronometer correction at 20h 40m 26s·141 ±·015

TRANSIT OBSERVATIONS.

Station : Suva. Date, August 17th, 1903. Observer : Otto Klotz.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of arc transit.	R.A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	η Serpentis	18 16 52 06	·06	·13	·18	·07	·02	51 86	18 16 20 47	31 59	09
	α Lyræ	34 13 97	·04	·54	·21	·04	·03	13 27	33 41 97	30	00
	ι Aquilæ	37 32 47	·06	·08	·18	·04	·02	32 29	37 01 06	23	07
	λ Pavonis	43 50 44	·08	·76	·38	·03	·01	50 89	43 19·65	24	06
	σ Sagittarii	49 50 13	·06	·08	·20	·02	·02	50 07	49 18·70	37	07
W	π Sagittarii	19 04 34 59	·16	·03	·19	·00	·02	34 63	19 04 03 32	31	01
	α Aquilæ	46 37 88	·12	·31	·18	·05	·02	37 56	46 06 33	23	07
	ι Sagittarii	49 09 45	·18	·27	·24	·06	·03	09 69	48 38 41	28	02
	δ Aquilæ	51 07 76	·14	·21	·18	·06	·02	07 51	50 36 20	31	01
	σ Sagittarii	57 16 77	·17	·10	·20	·07	·02	16 81	56 45 49	32	02

a = ·509 c = ·175

Chronometer correction at 19h 06m 31s·289 ± ·013.

W	θ Aquilæ	20 06 52 97	·14	·15	·23	·09	·02	52 98	20 06 21·41	31 57	11
	α^1 Capricorni	12 51 19	·15	·05	·23	·08	·02	51 28	12 19 86	·42	04
	α^2 Capricorni	13 15 37	·15	·05	·23	·08	·02	15 46	12 43 92	54	08
	α Pavonis	18 34 19	·22	·60	·41	·08	·04	35 02	18 03 69	·33	13
	ρ Capricorni	23 54 79	·16	·00	·24	·07	·02	54 92	23 23 34	58	12
	α Indi	31 20 06	·20	·38	·33	·06	·03	20 60	30 49 14	46	00
E	δ Aquarii	21 27 02 36	·06	·11	·23	·02	·02	02 04	21 26 30 68	36	10
	γ Gruis	48 38 71	·08	·22	·29	·04	·03	38 65	48 07 19	46	00
	α Aquarii	22 01 23 37	·06	·16	·23	·06	·02	22 96	22 00 51 56	40	06
	ι Pegasi	03 05 41	·05	·39	·25	·07	·02	04 73	02 33 29	·44	02
	α Toucani	12 27 38	·10	·73	·46	·08	·04	27 63	11 56 08	·55	09
	γ Aquarii	17 14 00	·06	·15	·23	·08	·02	13 58	16 42 19	39	07
	σ Aquarii	26 06 06	·07	·06	·23	·09	·02	05 73	25 34 27	46	00

a = ·524 c = ·225

Chronometer correction at 21h 15m 31s·461 ± ·017

TRANSIT OBSERVATIONS.

Station: SUVA. Date, August 19th, 1903. Observer: OTTO KLOTZ

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	
E	72 Ophiuchi	18 03 22 47	-·02	·22	·18	-·12	·02	22 19	18 02 47 57	34 32 ·00
	η Serpentis	16 55 09	-·03	·12	·18	·10	·02	54 90	16 20 45	·45 ·13
	α Telescopii	20 25 32	-·03	-·32	·26	-·09	·03	25 47	19 51 19	·28 ·04
	λ Sagittarii	22 36 95	-·03	-·07	·20	-·09	·02	36 90	22 02 60	·30 ·02
	α Lyræ	34 16 88	-·02	·51	·23	·07	·03	16 20	33 41 94	·26 ·06
	σ Sagittarii	49 53 05	-·03	·08	·20	·05	·02	52 99	49 18 68	·31 ·01
W	ε Sagittarii	19 49 12 55	·17	·26	·24	·04	·03	12 81	19 48 38 13	·38 ·06
	ζ Sagittarii	57 19 85	·16	·09	·20	·05	·02	19 91	56 45 49	·42 ·10
	Delphini	20 29 12 70	·13	·23	·18	·10	·02	12 40	20 28 38 00	·31 ·01
	ι Indi	31 23 01	·18	·45	·20	·10	·03	23 31	30 49 14	·17 ·15
	ε Delphini	35 45 94	·12	·27	-·19	·11	·02	45 61	35 11 33	·28 ·04
	ι Aquarii	43 03 55	·14	·67	-·18	·12	·02	03 38	42 29 04	·34 ·02

a = -·476 c = -·179

Chronometer correction at 19h 23m 34s·3 7 -·017

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.
W	θ Capricorni	21 01 07 86	·13	·01	-·21	·09	·02	08 00	21 00 33 34	34 66 -·11
	ζ Cygni	03 26 76	·09	·43	·23	-·08	·02	26 53	08 51 99	·54 ·01
	δ Aquarii	27 05 18	·12	·11	-·20	·05	·02	05 18	26 30 69	·49 ·06
	ε Aquarii	33 13 33	·12	·09	·20	·04	·02	13 32	32 38 84	·48 ·07
	γ Capricorni	35 21 11	·13	·61	-·21	·04	·02	21 29	34 46 63	·57 ·02
	ε Pegasi	40 03 43	·11	·24	·20	·03	·02	03 29	39 28 78	·51 ·04
	δ Capricorni	42 19 34	·13	·02	·21	·03	·02	19 41	41 44 83	·58 ·03
E	σ Aquarii	22 26 08 98	·21	·06	·21	·04	·02	08 86	22 25 34 29	·57 ·02
	β Gruis	37 30 69	-·27	·37	·30	·06	·03	30 94	36 56 42	·52 ·03
	η Pegasi	39 06 08	-·16	·43	·23	·06	·02	05 50	38 30 97	·53 ·02
	λ Aquarii	48 11 33	-·20	·09	·20	·07	·02	11 15	47 36 63	·52 ·03
	δ Aquarii	50 08 22	-·21	·02	·21	·07	·02	08 11	49 33 54	·57 ·02
	α Piscis Aust	52 55 47	-·23	·12	·24	·08	·02	55 48	52 20 95	·53 ·02
	α Pegasi	23 00 34 20	-·18	·29	·21	·09	·02	33 77	59 59 19	·58 ·03

a = -·505 c = -·203

Chronometer correction at 22h 00m 34s·551 -·009

TRANSIT OBSERVATIONS

Station : Stva

Date, August 21st, 1903.

Observer Otto Kr

Clamp	Star	Transit over mean of threads	Level and inequality of pivots	Azimuth.	Collimation.	R. A.	Aberration	Seconds of time transit	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
L	72 Sagittarii	18 00 15 49	28	15	26	07	02	15 71	17 59 38 35	37 56	09
	72 Ophiuchi	03 25 51	32	08	32	07	02	25 28	18 02 47 81	44	03
	g Sagittarii	08 38 47	25	02	24	06	02	38 56	08 01 11	41	02
	π Serpentis	16 57 98	24	16	32	04	02	57 86	16 29 43	43	04
	α Telescopii	20 28 19	32	40	32	04	03	28 64	19 51 15	45	02
	λ Sagittarii	22 39 89	28	08	24	03	02	40 62	22 02	45	03
W	α Lyræ	34 19 76	01	64	28	01	03	19 39	33 41 [illegible]	49	02
	2 Aquilæ	57 38 34	01	10	32	03	02	38 46	37 01 02	41	03
	λ Pavonis	43 55 68	02	92	47	01	04	57 04	43 19 57	47	00
	π Sagittarii	49 55 88	01	10	[illegible]	02	02	56 20	49 18 66	54	07
	ε Aquilæ	55 53 73	01	34	[illegible]	03	02	53 58	55 16 17	41	06
	ζ Aquilæ	19 01 37 69	01	14	22	04	02	37 72	19 01 60 13	51	14
	π Sagittarii	04 40 44	01	03	24	04	02	40 66	04 03 28	38	[illegible]
	δ Aquilæ	21 17 23	01	22	12	07	02	17 15	20 39 69	46	01

s. 601 s. 220

Chronometer correct on at 18h 40m 37 479 ± 01 :

W	Aquilæ	19 57 15 64	09	21	25	07	02	13 82	19 50 36 18	37 64	01
	Sagittarii	57 22 56	11	10	28	06	02	23 09	[illegible] 45 48	61	02
	ω Aquilæ	20 06 18 88	10	15	25	04	02	30 10	20 06 21 46	70	07
	ω Capricorni	12 57 22	10	05	25	03	02	57 53	12 19 85	68	05
	ι Capricorni	13 21 29	10	05	25	05	02	21 60	12 43 92	68	05
	λ Pavonis	18 40 03	14	59	46	02	04	41 20	18 03 67	53	10
	ο Capricorni	24 00 07	11	00	26	01	02	01 03	23 25 35	70	07
L	δ Delphini	29 15 97	35	25	25	00	02	15 80	28 38 08	72	09
	ι Lyræ	41 26 38	51	37	40	00	03	26 83	40 40 13	70	07
	[illegible]	45 49 13	34	29	26	01	02	48 89	35 11 33	56	07
	[illegible] Aquilæ	43 06 72	37	08	12	02	02	06 72	42 29 04	68	05
	ι Piscis Austr.	46 01 85	45	15	30	05	02	02 08	55 24 48	60	03
	ω Capricorni	21 01 10 81	41	01	26	06	02	10 87	00 33 34	53	10
	[illegible] Cygni	09 29 99	30	41	19	07	02	29 47	08 51 99	48	15

s. 513 s. 252

Chronometer correct on at 20h 30m 37 630 ± 015

TRANSIT OBSERVATIONS.

Station: SUVA. Date, August 22nd, 1903. Observer: OTTO KLOTZ.

Clamp	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	v.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	ζ Ara	17 17 57·21	·07	-·51	·38	·11 ·28	·04	57·65	17 17 18·71	38·94	·05
	ω Ophiuchi	22 23 68	-·05	·19	·22	·27	·02	23·57	21 44·72	·85	·04
	λ Scorpii	27 13·60	·07	-·19	·28	·26	·03	43·81	27 04·91	·90	-·01
	α Ophiuchi	31 07·52	·05	·25	·22	·25	·02	07·33	30 28·44	·89	·00
	ι Pavonis	36 56·59	·09	-·82	·51	·24	·05	57·18	36 18·33	·85	·01
	ξ Ophiuchi	39 22·58	·05	·19	·22	·24	·02	22·44	38 43·54	·90	·01
W	γ Capricorni	21 35 25·56	·00	·01	·23	·19	·02	25·57	21 34 46·64	·93	·04
	ε Pegasi	40 07·83	·00	·23	·22	·20	·02	07·60	39 28·79	·81	·08
	δ Capricorni	42 23·82	·00	·01	·23	·21	·02	23·81	41 44·84	·97	·08
	γ Gruis	48 45·98	·00	-·20	·28	·22	·03	46·21	48 07·23	·98	·09
	α Gruis	22 02 49·75	·00	-·35	·32	·24	·03	50·15	22 02 11·36	·79	·10
	γ Aquarii	17 21·35	·00	·14	·22	·27	·02	21·14	16 42·23	·91	·02

a = -·485 c = ·217

Chronometer correction at 19h 49m 38s·894 ± ·012

W	η Aquarii	22 31 04·96	·02	·16	·21	·08	·03	05·04	22 30 25·77	39·27	·00
	β Gruis	37 35·02	·02	·39	·31	·07	·03	35·74	36 56·46	·28	·01
	α Pegasi	23 00 38·60	·01	·30	·21	·03	·02	38·51	59 59·23	·28	·01
	γ Piscium	12 50·81	·02	·19	·21	·01	·02	50·80	23 12 11·62	·18	·09
	γ Pegasi	16 33·17	·02	·33	·23	·00	·02	33·03	15 53·72	·31	-·04
E	κ Piscium	22 40 36	-·28	·17	·21	·01	·02	40·23	22 00·96	·27	·00
	ι Piscium	35 40·48	-·28	·21	·21	·04	·02	40·28	35 01·00	·28	·01
	δ Sculptoris	44 34·79	-·34	-·11	·24	·05	·02	34·93	43 55·65	·28	·01
	φ Pegasi	48 16·29	·25	·34	·22	·06	·02	15·90	47 36·65	·25	·02
	ω Piscium	55 02·63	·28	·22	·21	·7	·02	02·39	54 23·12	·27	·00
	ο Ceti	59 28·67	·32	·01	·22	·08	·02	28·66	58 49·40	·26	·01

a = -·536 c = -·210

Chronometer correction at 23h 15m 39s·266 ± ·009

TRANSIT OBSERVATIONS.

Station: Suva. Date: August 23rd, 1903. Observer: Otto Klotz.

Clamp	Star	Transit over mean of threads.	Level and equality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	θ Capricorni	21 01 13 81	17	01	24	06	02 13 81		21 00 33 34	40 47	01
	ε Cygni	09 32 98	17	46	26	05	02 32 41		08 51 98	43	03
	α Equulei	11 42 71	17	21	25	05	02 12 45		11 01 98	47	07
	ω Microscopii	15 17 84	18	29	25	04	03 18 02		14 37 47	55	00
	ε Capricorni	21 51 06	17	05	25	03	02 51 94		21 11 49	45	01
	δ Aquarii	27 11 30	16	12	25	02	02 11 11		26 30 70	41	05
	γ Capricorni	35 27 15	17	01	23	01	02 27 07		34 46 65	42	04
W	ε Pegasi	40 09 45	12	26	23	00	02 09 28		39 28 79	49	03
	δ Capricorni	42 25 27	14	02	24	01	02 25 32		41 44 84	48	02
	γ Gruis	48 17 39	16	33	29	02	03 17 70		48 07 25	45	01
	20 Pegasi	57 05 98	15	29	24	03	02 05 76		56 25 30	46	00
	ε Aquarii	22 01 32 11	13	16	23	04	02 32 02		22 00 51 66	42	04
	γ Aquarii	17 32 94	14	15	23	05	04 36 60		11 56 17	45	03
						06	02 22 80		16 42 24	56	10

a 543 227

Chronometer correction at 21h 30m 40 461 0/0

TRANSIT OBSERVATIONS.

Station: Suva. Date: August 25th, 1903. Observer: Otto Klotz.

Clamp.	Star.	Transit over mean of threads.	Level and equality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	α Toucani	22 12 37 26	45	60	50	10					
	η Aquarii	31 07 54	29	13	24	12	04 37 89		22 11 56 19	41 70	03
	ε Pegasi	37 22 77	27	21	25	09	02 07 53		30 25 79	74	07
	γ Pegasi	39 13 00	23	37	28	08	02 22 64		36 40 36	68	01
	ε Gruis	43 26 92	40	38	39	08	02 12 64		38 31 02	62	05
	λ Aquarii	48 18 37	30	07	24	07	03 27 35		42 45 72	63	04
	δ Aquarii	50 15 17	31	01	25	06	02 18 40		47 36 70	70	03
						06	02 15 26		49 33 60	66	01
W	ω Piscium	23 55 04 89	01	18	24	05	02 04 87		23 54 23 17	70	03
	ι Ceti	59 30 93	01	00	25	06	02 31 09		58 49 15	64	03
	α Andromedæ	24 04 08 03	00	36	25	06	02 07 86		24 03 26 07	79	12
	γ Pegasi	08 59 61	01	24	25	07	02 59 52		08 17 86	66	01
	α Phœnicis	22 13 57	01	24	33	09	03 11 01		21 32 18	53	14
	δ Andromedæ	34 53 98	01	33	27	11	02 [illegible] 79		34 12 10	69	02
	ζ Ceti	39 27 81	01	00	[illegible]	12	02 27 90		38 46 24	66	04

a 431 243

Chronometer correction at 23h 25m 41 674 0/0

TRANSIT OBSERVATIONS.

Station: SUVA. Date, August 27th, 1903. Observer: OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and equality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	c.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	μ Herculis	17 43 25·39	·08	·47	·27	·06	·02	24·71	17 42 41·98	42·76	·06
	89 Herculis	52 16 19	·08	·45	·27	·02	·02	15·55	51 32 79	·76	·06
	ν Ophiuchi..	54 27 22	·10	·09	·24	·02	·02	26·99	53 44 15	·84	·02
	γ² Sagittarii.	18 00 20·99	·11	·15	·28	·01	·02	20·96	59 38 05	·91	·09
	72 Ophiuchi..	03 31 02	·09	·28	·24	·01	·02	30·58	18 02 47 75	·83	·04
	μ Sagittarii.	08 44 00	·10	·02	·26	·01	·02	43·85	08 01 03	·82	·00
W	η Serpentis..	17 03 33	·22	·15	·24	·00	·02	03·18	16 20 35	·83	·01
	α Telescopii	20 33 42	·29	·30	·35	·01	·03	33·83	19 51 05	·78	·04
	λ Sagittarii	22 45 31	·25	·08	·27	·01	·02	45·38	22 02 49	·89	·07
	α Lyræ	34 25 19	·16	·03	·31	·02	·03	24·66	33 41 79	·87	·05
	ι Aquilæ	37 43 86	·23	·09	·24	·02	·02	43·74	37 00 95	·79	·03
	λ Pavonis	44 01 22	·36	·88	·52	·03	·04	02·19	43 19 41	·78	·04

a = ·536 c = ·242

Chronometer correction at 18h 13m = 12s·825 ·011

Clamp.	Star.	Transit over mean of threads.	Level and equality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	c.
W	ε Aquilæ	18 55 59·22	·18	·32	·28	·04	·02	59·02	18 55 16·09	42·93	·03
	ζ Aquilæ	19 01 43·20	·18	·31	·28	·04	·02	43·01	19 01 00·05	·96	·06
	ψ Sagittarii	10 22 01	·23	·08	·30	·03	·02	22·17	09 39 21	·96	·06
	ω Aquilæ	14 01 93	·19	·28	·27	·03	·02	01·74	13 18 84	·90	·00
	B.A.C. 6632 ..	20 47 84	·29	·58	·46	·02	·04	48·57	20 05 72	·85	·05
	α Vulpeculæ	25 26 31	·16	·42	·29	·01	·02	26·01	24 43 11	·90	·00
	α Aquilæ	30 07 2[illegible]	·19	·25	·27	·01	·02	07·08	29 24 22	·86	·04
E	δ Sagittarii	35 56 55	·19	·02	·28	·00	·02	56·42	35 13 47	·95	·05
	γ Aquilæ	42 2[illegible] 35	·17	·28	·27	·00	·02	24·95	41 42 06	·89	·01
	α Aquilæ	46 49 53	·15	·34	·27	·01	·02	49·04	46 06 26	·78	·12
	ι Sagittarii	49 21 16	·23	·31	·36	·01	·03	21·30	48 38 36	·94	·04
	δ Aquilæ	51 19 40	·16	·23	·27	·01	·02	19·03	50 36 15	·88	·02
	σ Sagittarii	57 28 37	·20	·11	·30	·02	·02	28·34	56 45 45	·89	·01
	ρ Capricorni	20 24 06 36	·19	·00	·28	·04	·02	06·21	20 23 23 31	·90	·05

a = ·565 c = ·267

Chronometer correction at 19h 40m = 12s·899 ·010

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date, August 14th, 1903. Observer: F. W. O. WERRY.

Champ.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of cont. transit	R. A.	Chronometer correction.	c.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
E	λ Scorpii	17 28 04·15	-·06	-·09	+·08	-·06	·02	04·42	17 27 05·04	59 38	03
	241	31 28·00	-·04	·35	-·07	-·04	·02	27·78	30 28·52	26	09
	600	33 04·37	-·05	·12	-·07	-·04	·02	04·39	32 05·04	35	00
	γ Pavonis	37 16·96	-·10	-·70	-·16	-·02	·04	17·90	36 18·60	30	05
	245	39 43·20	-·04	·28	·07	·00	·02	43·01	38 43·61	40	05
	246	43 41·99	-·03	-·49	·05	·02	·02	41·57	42 42·17	40	05
W	250	54 43·83	·02	·17	·08	·07	·02	43·52	53 44·27	25	10
	253	56 49·81	·02	·27	·07	·07	·02	49·40	55 50·09	31	04
	601	18 00 37·85	·02	-·02	·08	·09	·02	37·70	59 38·22	18	13
	254	03 47·74	·02	·33	·07	·11	·02	47·23	18 02 47·88	·35	00

$a = -\cdot518$ $c = +\cdot067$

Chronometer correction at $17^h\ 40^m$ = 59·348 ·019

W	603	18 50 18·47	+·04	-·03	·05	-·29	·02	18·70	18 49 18·69	1 00 01	03
	270	19 02 00·35	-·03	·39	·05	-·23	·02	00·15	19 01 00·14	00 01	03
	604	05 03·28	·04	·08	·05	-·22	-·02	03·39	04 03·30	00 00	-·11
	ψ Sagittarii	10 39·16	·04	·04	·05	-·19	·02	39·28	09 39·32	0 59·96	02
	ω Sagittarii	36 15·53	-·04	·12	·05	-·07	·02	13·45	35 13·55	59·90	08
	ι Sagittarii	49 38·21	-·05	+·17	-·06	-·05	·02	38·40	48 38·45	59·95	03
	283	51 36·45	·03	-·32	·05	·01	·02	36·08	50 36·18	59·90	08
E	607	20 13 44·13	-·08	-·25	+·05	·11	·02	43·88	20 12 43·91	59·97	01
	608	16 37·41	·09	·22	-·05	·13	·02	37·18	15 37·32	59·86	12
	α Pavonis	19 02·84	·14	+·75	-·08	·14	·03	03·64	18 03·69	59·95	03
	609	24 23·61	·09	·18	-·05	·16	·02	23·39	23 23·33	1 00·06	08
	280	29 38·66	·07	-·58	-·05	·19	·02	37·99	28 38·06	0 59·93	05
	297	43 29·45	-·07	-·29	-·05	·25	·02	29·01	42 28·93	1 00·08	10
	α Aquarii	48 29·32	-·07	-·30	-·05	·28	·02	28·84	47 28·85	0 59·99	01

$a_1 = +\cdot557$ $a_2 = +\cdot875$ $c = +\cdot045$

Chronometer correction at $19^h\ 50^m$ = 59·976 ·016

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date, August 17th, 1903. Observer: F. W. O. WEBBY.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	v.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
W	σ Ophiuchi ..	17 23 07 82	01	40	12	08	02	08 15	17 21 44 78	1 23 37	00
	η Pavonis	37 45 12	03	1 00	20	04	04	41 80	36 18 47	33	04
	245 ..	40 06 66	01	40	12	03	02	06 94	38 43 57	37	00
	246 ..	44 05 07	01	69	14	02	02	05 61	42 12 13	48	11
	250	55 07 47	01	24	12	01	02	07 55	53 44 24	31	06
	253	57 13 21	01	39	12	02	02	13 43	55 50 06	37	00
E	601 ..	18 01 01 47	07	02	14	03	02	01 61	59 38 19	42	·05
	254 .	04 10 57	05	46	12	04	02	11 14	18 02 47 86	28	09
	255 . . .	05 10 60	03	70	14	04	02	11 41	03 48 08	33	04
	ι Sagittarii ..	19 11 25	05	69	15	09	02	11 25	17 47 84	41	04

a = ·733 c = ·122

Chronometer correction at 17h 30m 1m 23s·368 ± ·016

E	λ Pavonis	18 44 43 46	07	59	34	09	04	43 33	18 43 19 64	1 23 69	09
	603 ...	50 41 90	04	03	17	07	02	42 19	49 18 67	52	08
	267 .	56 39 13	03	36	16	06	02	39 72	55 16 19	53	07
	270	19 02 23 22	03	35	16	04	02	23 78	19 00 60 13	65	05
	604	05 26 70	03	08	·17	03	02	26 99	04 63 27	72	12
	ζ Sagittarii...	11 02 54	03	04	17	01	02	02 77	09 39 30	·47	13
	495	14 41 98	03	33	16	00	02	42 48	13 18 89	59	01
W	B. A. C. 6632	21 30 12	02	37	27	02	03	29 41	20 05 85	56	04
	α Vulpeculæ	26 06 61	01	·44	17	·03	02	06 82	24 43 24	58	02
	605 . ..	32 15 74	02	04	17	05	02	15 52	30 51 99	53	07
	ζ Sagittarii ..	36 37 32	·02	11	16	06	02	37 17	35 13 52	65	05
	277	43 05 67	02	33	16	08	02	05 72	41 42 09	63	03
	279 ...	44 30 54	02	·39	16	·09	02	30 64	43 06 92	72	12

a = ·50 c = ·156

Chronometer correction at 19h 15m 1m 23s·601 ± ·018

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date, August 19th, 1903. Observer: F. W. O. WERRY.

Clamp.	Star.	Transit over mean of threads	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	".
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
E	4 Aræ	17 18 57 58	02	35	16	34					
	ζ Ophiuchi	23 24 21	00	25	09	17	03	58 21	17 17 18 79	1 39 42	07
	Scorpii	28 44 09	00	18	11	12	02	24 18	21 44 77	41	08
	Pavonis	37 57 14	02	51	21	07	02	14 08	27 04 97	41	08
	245	40 23 25	01	25	09	06	04	58 01	36 18 41	37	08
	46	44 21 98	01	42	10	03	02	23 14	38 43 55	39	10
							02	21 08	42 42 10	38	09
W	250	55 24 08	03	15	09	03	02	23 74	53 44 22	32	03
	253	57 29 9	03	24	09	04	02	20 18	55 50 03	45	04
	254	18 04 27 83	04	28	09	08	03	33 37	18 02 47 83	49	00
	257	05 28 26	04	45	10	09	02	37 32	03 48 05	47	02
	302	09 40 89	03	37	10	17	02	40 53	08 01 00	41	05
	Telescopii	21 30 98	00	19	13	18	03	40 77	19 51 19	38	09

σ 150 089

Chronometer correction at 17 30 1 39 494 016

W	603	18 50 58 76	03	02	10	23	02	38 82	18 49 18 6	1 40 16	10
	267	56 56 48	02	30	09	19	0	24	55 16 18	06	00
	270	19 02 40 41	02	29	09	16	02	40 15	19 01 00 10	05	01
	ζ Sagittarii	11 19 41	03	03	09	11	02	19 32	39 29	06	00
	B A C 6632	21 45 68	04	31	15	05	03	47 82	20 05 85	39 97	09
	Vulpeculæ	26 23 80	02	37	09	02	02	23 32	24 43 24	40 08	02
E	ζ Sagittarii	36 53 57	02	09	09	01	02	37	35 13 53	40 00	06
	277	43 22 31	02	27	09	08	02	32 05	41 42 08	39 97	09
	279	44 47 24	02	7	09	09	02	46 32	43 06 21	40 04	05
	Sagittarii	50 18 46	02	13	11	12	02	18 58	48 38 43	15	09
	283	52 16 51	01	24	09	13	02	16 32	50 36 16	06	00
	286	56 10 27	00	33	09	15	02	09 86	54 29 79	97	01
	287	20 08 01 84	00	26	09	22	02	01 49	20 06 21 34	15	09

σ 418 085

Chronometer correction at 19 30 1 40 060 015

TRANSIT OBSERVATIONS.

Station: Norfolk Island. Date, August 21st, 1903. Observer: F. W. O. Werry

Clamp.	Star	Transit over mean of threads	Level and equality of pivots	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of star transit.	R. A.	Chronometer correction.	c.
		h. m. s.	s.	s.	s.	s. r = ·47	s.		h. m. s.	m. s.	s.
E	286	19 56 25·51	·03	·47	+ ·04	+ ·28	·02	25·37	19 54 29·78	1 55·59	+ ·12
	ι Sagittarii	58 40·58	·04	·01	+ ·05	+ ·36	·02	40·00	56 45·48	·42	- ·05
	287	20 08 16·94	·04	·28	- ·04	+ ·17	- ·02	16·89	20 06 21·34	·55	+ ·08
	[illegible]	14 39·35	·04	·17	+ ·04	+ ·13	·02	39·37	12 43·90	·47	·00
	608	17 32·73	·04	·15	+ ·04	+ ·10	·03	32·73	15 37·51	·42	·05
	κ Pavonis	19 58·42	·06	+ ·51	+ ·07	+ ·09	·03	59·12	17 03·67	·45	·02
	609	25 18·70	·05	·12	+ ·04	·04	·02	18·69	23 23·33	·36	·11
W	295	44 21·92	·01	·20	·04	- ·11	·02	24·54	42 29·00	·54	·07
	α Aquarii	49 21·73	·00	·20	·04	·15	·02	24·32	47 28·87	·45	·02
	507	52 25·14	·00	·56	·05	·17	·02	24·34	50 28·96	·38	·09
	θ Capricorni	21 02 29·29	·02	·12	- ·04	·26	·02	28·87	21 00 33·34	·53	·06
	611	06 18·24	·03	·18	·04	·29	·02	17·74	04 22·18	·56	- ·09
	993	09 48·23	·03	·58	·05	·31	·02	47·30	08 51·96	·34	·13

a = + ·591 c = - ·040

Chronom. correction at 20h 30m = - 1m 55s·468 ± ·022

W	304	21 12 08·05	·06	·17	·23	+ ·22	·02	57·91	21 11 01·93	1 55·98	- ·08
	θ Microscopii	16 34·57	·00	·08	·30	- ·19	·02	33·62	14 37·47	56·15	+ ·09
	307	28 26·88	·07	·12	·23	- ·11	- ·02	26·69	26 30·63	·06	·00
	ξ Aquarii	34 35·12	- ·07	·11	·23	- ·10	- ·02	34·88	32 38·85	·03	·03
E	615	43 40·64	·14	·07	+ ·24	·02	·02	40·91	41 44·80	·11	- ·05
	β Gruis	50 02·83	·14	+ ·06	+ ·29	·08	·02	03·22	48 07·22	·00	·06
	311	22 02 47·70	·09	·14	+ ·23	- ·17	·02	47·69	22 00 51·55	·14	+ ·08
	α Gruis	04 07·00	·11	+ ·14	+ ·34	·19	·03	07·37	02 11·35	·02	·04

a = + ·298 c = + ·229

Chronometer correction at 21h 40m 1m 59s·062 ± ·028

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date, August 22nd, 1903. Observer, F. W. O. WEBBY.

Clamp	Star.	Transit over mean of threads.	Level and azimuth.	Azimuth.	Collimation.	Rate.	Mir.	Zenith.	R. A.	Chronometer correction.
		h. m. s.	s.	s.	s.	s.			h. m. s.	m. s. s.
E	241	17 32 39 21	05	26	19	13	02	30 32	17 30 28 40	2 01 02 05
	600	31 06 50	07	09	20	12	02	06 78	32 04 04	34 03
	? Pavonis	38 18 98	13	51	11	10	01	90 12	38 18 33	22 05
	245	40 45 29	06	21	19	09	02	45 10	38 43 51	37 02
	246	44 44 03	04	35	21	07	02	43 78	42 42 04	34 07
	250	55 45 96	07	12	19	02	02	46 70	53 44 17	03 06
	253	57 51 80	06	20	19	01	02	51 84	55 49 95	35 02
W	601	18 01 40 22	05	01	22	00	02	40 04	20 38 12	32 05
	257	18 22 6	04	17	19	00	02	22 17	18 16 20 38	79 08
	? Telescopii	21 53 13	07	16	23	10	02	52 96	19 51 1.	33 04
	2 Apodis	39 03 27	05	13	19	19	02	02 79	37 01 02	11 10
	263	43 34 53	04	30	20	20	02	33 87	41 32 04	41 06
	λ Pavonis	45 21 63	09	41	11	21	04	21 50	43 19 54	06 09

a = ·376 c = ·189

Chronometer correction at 18h 00m 2m 01·806 ·013

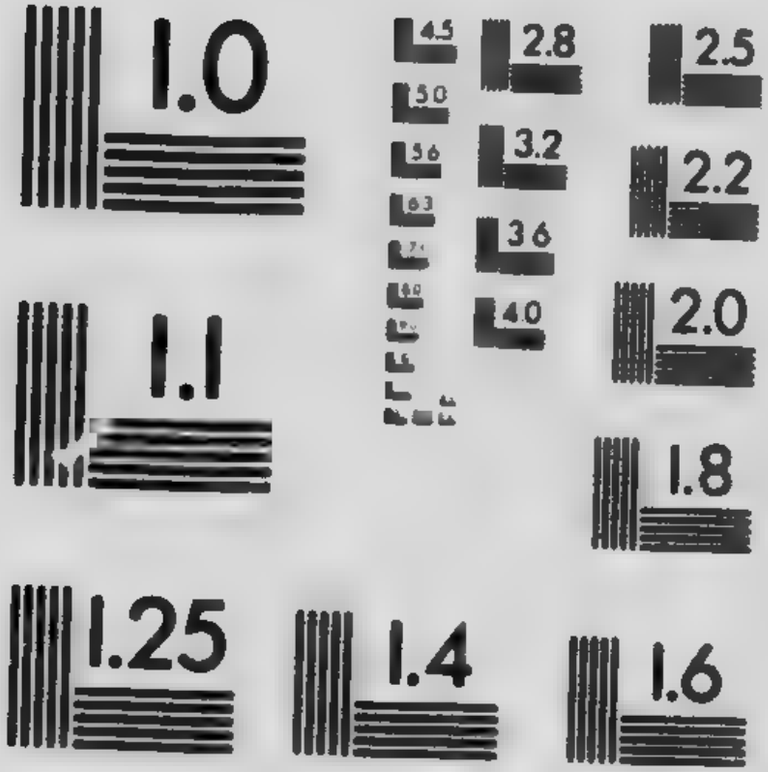
W	604	19 06 05 59	04	07	07	·16	02	05 63	19 04 03 24	2 02 39	05
	ψ Sagittarii	11 11 51	05	03	07	·14	02	41 58	09 39 26	32	02
	195	15 21 44	05	·31	06	·12	02	21 22	13 18 85	37	03
	B.A.C. 6632	22 07 73	11	·35	11	·08	03	08 13	20 05 80	33	01
	ι Vulpeculæ	26 45 88	·05	42	07	07	02	45 49	24 43 29	29	05
	275	28 54 31	04	45	07	06	02	53 87	26 51 57	30	04
	605	32 54 32	08	04	07	·04	02	54 31	30 51 96	35	01
E	277	43 44 54	12	31	06	01	02	44 38	41 42 06	32	02
	ζ Sagittarii	50 40 37	20	15	08	·05	02	40 73	48 38 40	33	01
	283	52 38 65	14	27	06	06	02	38 50	50 36 14	36	02
	286	56 32 41	12	37	07	·07	02	32 14	54 29 77	37	03
	σ Sagittarii	58 47 55	21	01	07	·09	02	47 71	56 45 48	23	11
	287	20 08 23 89	18	22	06	·14	02	23 75	20 06 21 34	41	07

a = ·474 c = ·062

Chronometer correction at 19h 40m 2m 02·338 ·010

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



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TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date, August 23rd, 1903. Observer, F. W. O. WERRY.

Champ.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R.A.	Chronometer correction.	r.
		h. m. s.	s.	s.	s.	s. r = ·30	s.		h. m. s.	m. s.	s.
E	λ Scorpii	17 29 13·89	− ·09	− ·08	− ·11	− ·16	− ·02	14·13	17 27 04·89	2 09·24	− ·02
	241.....	32 37·78	− ·06	− ·33	− ·09	− ·14	− ·02	37·60	39 28·39	·21	·01
	600.....	34 14·04	− ·07	− ·12	− ·09	− ·13	− ·02	14·05	32 04·92	·13	·09
	η Pavonis.....	38 26·53	− ·14	+ ·67	− ·20	− ·11	·04	27·33	36 18·29	·04	·18
	245.....	40 52·85	− ·06	·27	− ·09	− ·10	·02	52·69	38 43·49	·20	·02
	246.....	44 51·51	− ·04	− ·46	+ ·10	− ·08	− ·02	51·17	42 42·02	·15	·07
	253.....	57 59·42	− ·06	− ·26	− ·09	+ ·01	·02	59·18	55 49·98	·20	·02
W	601.....	18 01 47·70	− ·10	− ·01	− ·10	− ·01	− ·02	47·48	59 38·10	·38	− ·16
	254.....	04 57·55	− ·06	− ·31	− ·09	− ·02	− ·02	57·05	18 02 47·77	·28	− ·06
	602.....	10 10·49	− ·09	− ·07	− ·09	− ·05	− ·02	10·17	08 01·03	·14	·08
	257.....	18 30·05	− ·07	− ·22	− ·09	− ·10	− ·02	29·55	16 20·37	·18	·04
	ε Sagittarii....	19 57·43	− ·10	+ ·06	− ·11	− ·10	− ·02	57·16	17 47·77	·39	− ·17
	α Telescopii.....	22 00·66	− ·11	+ ·21	− ·13	− ·11	·03	00·49	19 51·12	·37	− ·15
	λ Sagittarii.....	24 12·08	− ·09	− ·03	− ·10	− ·12	− ·02	11·72	22 02·55	·17	·05

$a = +{}^{s}\cdot490$ $c = -{}^{s}\cdot088$

Chronometer correction at $18^h\ 00^m = -2^m\ 09^s\cdot220 \quad {}^{s}\cdot022$

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date. August 25th, 1903. Observer: F. W. O. WERRY.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R.A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
E	η Pavonis ..	17 38 42·21	-·04	-·54	-·04	-·36	02	63·15	17 36 18·21	2 24·94	·01
	245	1 08·21	-·02	·22	-·02	-·35	02	08·36	38 43·46	·90	·05
	246	45 07·06	-·01	-·37	-·02	-·30	02	67·00	42 41·98	25·02	·07
	250. .	56 08·95	-·02	·13	-·02	-·26	02	09·10	53 44·13	24·[illegible]	-·02
	254	18 05 12·66	-·04	·25	-·02	-·20	02	12·62	18 02 47·75	·87	[illegible]
W	602..	10 25·82	·03	·06	·02	·17	02	25·92	08 01·00	·92	·03
	ε Sagittarii .	20 12·55	·03	-·05	-·02	·12	02	12·73	17 47·74	·99	·04
	283. . . .	19 53 01·75	·02	·23	-·02	·45	02	01·07	19 50 36·12	·95	·00
	286.. . . .	56 55·50	·02	·31	·02	·44	02	54·73	54 29·74	·99	·04
	ζ Sagittarii . .	59 10·86	·03	-·01	·02	·46	02	10·38	56 45·45	·93	·02

$a = +^s 398$ $c = -^s 016$

Chronometer correction at $18^h\ 40^m$ $2^m\ 24^s\cdot 954 - ^s 011$

W	287	20 08 47·07	-·02	-·19	-·03	·19	02	47·04	20 06 21·32	2 25·72	·08
	697. . . .	15 09·52	-·03	-·11	·03	-·15	·02	09·54	12 43·88	·66	-·02
	608	18 02·79	-·03	-·10	·03	-·13	02	02·80	15 37·20	·60	·04
	α Pavonis	20 28·81	-·05	-·34	-·05	-·12	·03	29·24	18 03·63	·61	·03
	290..	31 03·92	-·02	·26	-·03	-·05	02	03·68	28 38·03	·65	-·01
	292..	35 29·27	-·02	·28	-·03	-·02	·02	28·98	33 03·33	·65	·01
E	297..... ..	44 54·74	·08	-·13	-·03	·03	·02	54·67	42 28·19	·68	·04
	α Aquarii.....	49 54·55	-·08	·13	-·03	·05	02	54·46	47 28·86	·60	·04
	507....	52 54·96	-·05	-·37	-·03	·07	·02	54·58	50 28·94	·64	·00
	ι Piscis Aust...	57 50·11	-·09	-·03	-·03	-·19	02	50·14	55 24·47	·67	-·03
	θ Capricorni . .	21 02 58·98	-·08	-·08	-·03	·13	02	58·86	21 00 33·34	·52	-·12
	304...	13 27·91	-·07	-·22	-·03	·14	·02	47·81	04 22·18	·63	·01
	θ^1 Microscopii..	17 03·23	-·10	-·11	-·04	·22	·02	03·24	11 01·93	·65	-·01
									14 37·48	·76	-·12

$a = +^s 394$ $c = -^s 027$

Chronometer correction at $20^h\ 40^m$ - $2^m\ 25^s\cdot 645 - ^s 013$

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date, August 27th, 1903. Observer: F. W. O. WERRY.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R.A.	Chronometer correction.	v.
		h. m. s.	s.	s.	s.	s. r 30	s.		h. m. s.	m. s.	s.
E	λ Sagittarii	18 24 42·76	·08	− ·04	+ ·03	·18	·02	42·83	18 22 02·49	2 40·34	·00
	ι Aquilæ	39 41·44	·07	− ·17	+ ·03	·10	·02	41·31	37 00·95	36	− ·02
	263	44 12·66	·05	·41	+ ·03	·08	·02	12·29	41 31·97	32	·02
	λ Pavonis	45 59·20	·13	− ·60	+ ·06	·07	·04	59·76	43 19·41	35	+ ·01
	603	51 58·96	·08	− ·01	+ ·08	·04	·02	58·92	49 18·56	36	− ·02
W	267	57 56·87	·07	− ·36	·03	·01	·02	56·40	55 16·09	31	·03
	270	19 03 40·96	·07	− ·35	·03	·02	·02	40·47	19 01 00·05	·12	− ·08
	ψ Sagittarii	12 19·68	·10	·04	·03	·06	·02	19·43	09 39·21	22	·12
	495	15 59·64	·07	− ·33	·03	·08	·02	59·11	13 18·80	31	·03
	B.A.C. 6632	22 46·06	·14	− ·37	− ·05	·12	·03	46·09	20 05·72	37	− ·03
	α Vulpeculæ	27 24·20	·06	− ·45	·03	·13	·02	23·51	24 43·14	37	− ·03

a = + ·506 c = ·028

Chronometer correction at 19h 00m 2m 40s·339 ± ·010

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date, September 29th, 1903. Observer: F. W. O. WERRY.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	v.
		h. m. s.	s.	s.	s.	s. r ·30	s.		h. m. s.	s.	s.
E	615	21 41 52·68	+ ·04	− ·06	− ·15	+ ·19	·02	52·68	21 41 44·68	− 08·00	− ·06
	616	22 01 23·49	·01	− ·07	·14	+ ·09	·02	23·36	22 01 15·38	07·98	− ·08
	312	02 41·66	·00	− ·26	− ·15	+ ·09	·02	41·32	02 33·23	08·09	+ ·03
	314	05 30·07	·01	− ·16	− ·14	·07	·02	29·83	05 21·82	08·01	− ·05
	α Toucani	12 04·12	+ ·01	+ ·31	− ·29	+ ·04	·04	04·15	11 56·00	08·15	+ ·09
	317	16 50·51	+ ·01	− ·13	− ·14	+ ·02	·02	50·25	16 42·21	08·04	− ·02
	π Aquarii	20 31·25	+ ·01	− ·14	·14	·00	− ·02	30·96	20 22·86	08·10	+ ·04
W	σ Aquarii	25 42·45	·03	− ·09	+ ·14	·03	·02	42·42	25 34·38	08·04	− ·02
	320	30 33·94	·03	− ·14	+ ·14	·05	·02	33·84	30 25·79	08·05	− ·01
	β Gruis	37 04·34	·04	− ·14	+ ·21	·08	·03	04·54	36 56·52	08·02	− ·04
	323	42 03·54	·02	− ·25	+ ·15	·11	·02	03·29	41 55·16	08·13	− ·07
	μ Pegasi	31·34	·02	− ·25	+ ·15	·13	·02	31·07	45 22·96	08·11	+ ·05

a = + ·289 c = − ·140

Chronometer correction at 22h 20m = 8s·059 ± ·014.

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date, October 1st, 1903. Observer: F. W. O. WERRY.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Zenith Distance.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	θ Capricorni	21 00 59·77	+·19	·09	·08	·13	·02	59 00	21 00 33·05	26·85	·04
	611	04 48·73	+·17	−·12	·08	·11	·02	48·79	04 21·91	·88	·01
	304	11 28·69	·15	+·23	·08	·08	·02	28·59	11 01·66	·93	·04
	θ¹ Microscopii	15 03·87	+·23	+·12	−·11	·06	·02	04·15	14 37·14	27·01	·12
	ι Capricorni	17 20·99	+·19	+·09	+·08	·05	·02	21·01	16 54·14	26·90	·01
	γ Pavonis	18 56·81	+·35	+·60	−·19	·05	·04	57·58	18 30·74	·84	·05
	612	21 37·97	+·19	·05	·09	·04	·02	38·04	21 11·20	·84	·05
W	307	26 57·28	+·08	+·16	+·08	·02	·02	57·28	26 30·43	·85	·04
	ε Aquarii	33 05·44	+·08	−·15	+·08	·01	·02	05·42	32 38·67	·75	·14
	ι Pegasi	39 55·71	+·06	·26	+·08	·04	·02	55·53	39 28·61	·92	·03
	615	42 11·60	+·09	·09	+·08	·05	·02	11·61	41 44·65	·95	·07
	γ Gruis	48 33·81	+·11	+·08	+·10	·08	·02	34·00	48 07·07	·93	·04

a +·412 c +·079

Chronometer correction at 21h 30m 26s·889 +·015

E	616	22 01 42·55	·13	·14	·08	−·20	·02	42·64	22 01 17·36	27·28	·06
	α Toucani	12 22·23	+·23	+·57	·16	·15	·04	22·98	11 55·95	·03	·19
	317	17 09·61	+·12	·24	·08	·13	·02	09·52	16 42·19	·33	·11
	π Aquarii	20 50·21	·12	·26	·08	+·12	·02	50·09	20 22·84	·25	·03
	β Gruis	37 23·49	·19	+·25	·11	·05	·03	23·84	36 56·50	·34	·12
	323	42 22·69	+·03	·45	·08	·03	·02	22·26	41 55·15	·11	·11
W	μ Pegasi	45 50·39	+·03	−·46	+·08	+·02	·02	50·04	45 22·94	·10	·12
	326	48 04·01	+·05	−·19	+·08	·01	·02	03·94	47 36·73	·21	·01
	618	50 00·88	+·05	−·12	+·08	·00	·02	00·87	49 33·65	·22	·00
	329	23 00 26·93	+·03	−·37	+·08	·04	·02	26·61	59 59·34	·27	·05
	621	38 12·53	+·02	−·13	+·08	·19	·02	12·29	23 37 45·06	·23	·01
	71 Aquarii	39 41·32	+·02	−·10	+·08	·20	·02	41·10	39 13·81	·29	·07

a +·527 c +·076

Chronometer correction at 22h 50m 27s·219 +·021

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date, October 2nd, 1903. Observer: F. W. O. WERRY.

Camp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	c.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	616	22 01 50·88	·00	·11	·10	+ ·16	·02	50·81	22 01 15·35	- 35·46	- ·07
	312	03 08·93	·00	·38	- ·10	+ ·16	·02	08·59	02 33·20	·39	·00
	314	05 57·51	·00	·24	·09	+ ·14	·02	57·30	05 21·80	·50	- ·11
	α Toucani	12 30·94	·00	- ·46	·19	+ ·11	- ·04	31·28	11 55·93	·35	·04
	317	17 17·74	·00	·20	·09	+ ·08	·02	17·48	16 42·18	·30	- ·09
	π Aquarii	20 58·49	·00	·21	- ·09	+ ·05	·02	58·22	20 22·84	·38	·01
W	β Gruis.	37 31·68	·06	+ ·20	+ ·14	·04	·03	31·89	36 56·49	·40	- ·01
	323	42 30·89	·03	·37	+ ·10	- ·07	·02	30·50	41 55·14	·36	·03
	326	48 12·42	·04	·15	+ ·09	·10	·02	12·20	47 36·72	·48	- ·09
	618	50 09·19	·04	·10	+ ·10	- ·12	·02	09·01	49 33·64	·37	- ·02
	329	23 00 35·11	·03	·30	+ ·10	- ·18	·02	34·68	59 59·33	·35	·04
	620	04 55·60	·04	- ·06	+ ·10	- ·20	- ·02	55·38	23 04 20·02	·36	·03

$a = +^{s}\cdot425$ $c = -^{s}\cdot094$

Chronometer correction at $22^{h}\ 30^{m}$ $-35^{s}\cdot388 - ^{s}\cdot013$

TRANSIT OBSERVATIONS.

Station : NORFOLK ISLAND. Date, October 3rd, 1903. Observer : F. W. O. WEBB

Clamp.	Star.	Transit over mean of threads	Level and inequality of pivots	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	c.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
W	θ¹ Microscopii	21 15 18·76	·02	- ·12	- ·15	+ ·22	·02	19·21	21 14 37·11	-42·10	- ·19
	ι Capricorni	17 35·88	·01	·09	- ·12	+ ·21	·02	36·09	16 54·11	41·98	- ·07
	γ Pavonis	19 11 59	- ·02	+ ·62	+ ·27	+ ·20	·04	12·62	18 30·67	·95	- ·04
	612	21 52·92	·01	- ·05	- ·12	+ ·18	·02	53·14	21 11·18	·96	·05
	307	27 12·26	·01	·13	- ·11	+ ·15	·02	12·33	26 30·41	·92	- ·01
	δ Aquarii	33 20·56	·01	·15	+ ·11	- ·11	·02	20·60	32 38·65	·95	- ·04
E	616	22 01 57·48	- ·05	·11	- ·11	·07	·02	57·22	22 01 15·34	·88	·03
	312	03 15·61	- ·03	·38	·12	·08	·02	15·04	02 33·19	·85	- ·06
	314	06 04·04	- ·04	·24	·11	- ·10	·02	03·61	05 21·79	·82	·09
	α Toucani	12 37·53	- ·09	- ·46	·23	- ·14	- ·04	37·67	11 55·91	·76	·15
	317	17 24·55	- ·04	·19	·11	- ·17	- ·02	24·10	16 42·18	·92	·01
	π Aquarii	21 05·24	- ·04	·21	·11	- ·20	·02	04·74	20 22·83	·91	·00

$a = +^s\cdot423$ $c = -^s\cdot111$

Chronometer correction at $21^h50^m = -41^s\cdot915 - ^s\cdot018$

E	σ Aquarii	22 26 16·59	+ ·06	- ·13	- ·08	- ·28	- ·02	16·70	22 25 34·32	-42·38	- ·02
	320	31 08·22	+ ·06	- ·19	- ·08	+ ·25	·02	08·24	30 25·76	·48	- ·08
	δ Gruis	37 38·45	+ ·09	+ ·19	- ·11	+ ·21	·03	38·80	36 56·48	·32	·08
	323	42 37·80	+ ·04	- ·35	- ·08	+ ·18	- ·02	37·57	41 55·13	·44	- ·04
	μ Pegasi	46 05·49	+ ·04	- ·36	- ·08	+ ·15	- ·02	05·22	45 22·93	·29	·11
	φ Aquarii	23 10 04·12	- ·06	- ·16	- ·08	·00	- ·02	03·92	23 09 21·47	·45	- ·05
	γ Toucani	12 32·45	+ ·11	+ ·39	- ·15	- ·01	- ·04	32·75	11 50·29	·46	- ·06
W	534	22 43·8	- ·02	- ·20	+ ·08	- ·08	- ·02	43·56	22 01·15	·41	- ·01
	333	35 44·11	- ·02	- ·23	+ ·08	- ·16	·02	43·76	34 61·28	·48	- ·08
	621	38 27·62	- ·02	- ·10	+ ·08	- ·18	- ·02	27·38	37 45·06	·32	- ·08
	β Aquarii	39 56·42	·02	- ·08	+ ·08	- ·18	- ·02	56·20	39 13·80	·40	·00

$a = +^s\cdot405$ $c = -^s\cdot077$

Chronometer correction at $23^h10^m = -42^s\cdot404 - ^s\cdot020$

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date, October 8th, 1905. Observer: F. W. O. WEELY.

Clamp.	Star.	Transit over mean of threads	Level and collimation capacity of pivots.	Azimuth	Collimation	Rate	Aberration.	Seconds of corr. for transit	R A	Chronometer correction.	ν.
		h m s.	s.	s.	s.	s.	s.		h m s.	m. s.	s.
E	σ Aquarii.	22 27 02 53	07	15	18	38	02 02 63		22 25 34 30	1 28 33	01
	320 .	31 54 16	07	23	18	35	02 54 15		30 25 73	42	08
	ε Grus	38 24 12	10	23	27	31	03 24·75		36 56 42	33	01
	329 .	23 01 28 02	05	- 35	19	17	02 27 68		59 59 30	38	04
	629	05 48 36	08	07	19	14	02 48 30		23 04 20 00	30	04
	φ Aquarii . .	10 49 92	- 07	19	·18	11	02 49 71		00 21·46	25	09
	γ Toucani .	13 18·29	·13	- 47	35	10	04 18 60		11 50 24	36	02
W	531	17 22 38	02	70	20	07	02 22 11		15 53 87	24	10
	622 .	45 24 40	02	·01	- 21	00	02 24 47		43 55 93	54	20
	336.	55 52 17	02	·35	- ·18	15	02 51 81		54 23 45	36	02
	ι Ceti	24 00 18 31	02	- ·12	- ·19	17	02 18 17		58 49 80	37	03
	33 Piscium.....	01 54 47	02	23	·18	19	02 54 19		24 00 25·84	35	01
	3	09 47 05	02	42	19	24	02 46 54		08 18 21	33	01
	εToucani. . .	16 32 92	·04	- ·84	- 43	28	04 33 83		15 05 55	28	06

a_1 = ·189, a_2 = ·587, c = ·180

Chronometer correction at 23h 30m 1m 28s·315 ± ·015

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date, October 11th, 1903. Observer: F. W. O. WILLY

Change.	Star.	Transit over mean of threads	Level and inequality of pivots	Azimuth	Collimation	Rate	Aberration.	Seconds of clock transit	R. A.	Chronometer correction	
		h m s.	s.	s.	s.	s.	s.		h m s.	m s.	s.
E	γ Gruis	21 50 01·35	-·12	-·08	·20	·15	·02 01·48	21 48 06·93	1 54·55		·18
	616	22 03 09·85	-·09	·11	·16	·10	·02 09·75	22 01 15·25	·50		·03
	312	04 27·81	·06	·37	·17	·09	·02 27·40	02 33·09	·31		·16
	314	07 15·46	-·08	·23	·16	-·08	-·02 16·21	05 21·70	·51		·04
	α Toucani	13 49·79	-·17	-·45	·32	·06	·04 50·11	11 55·72	·39		-·08
	π Aquarii	22 17·57	-·08	·21	·16	-·03	-·02 17·29	20 22·75	·54		·07
	σ Aquarii	27 28·94	-·09	·13	·16	-·01	·02 28·73	25 34·24	·49		·02
W	β Gruis	38 50·49	·05	-·20	-·23	·03	-·03 50·81	36 56·37	·44		-·03
	323	43 49·78	·02	·36	·17	·05	·02 49·50	41 55·07	·43		·04
	α Pegasi	47 17·69	-·02	·37	-·17	-·06	-·02 17·39	45 22·89	·50		-·03
	326	49 31·28	·03	-·15	-·16	-·07	-·02 31·17	47 36·66	·51		-·04
	618	51 28·18	·03	·10	-·16	·08	·02 28·11	49 33·58	·53		-·06
	329	23 01 53·02	·02	·30	·16	·11	·02 53·03	59 59·28	·35		·12
	620	06 14·53	·04	-·06	-·17	·13	·02 14·45	23 04 19·98	·47		·00

a = +s·415 c = -·176

Chronometer correction at 22h 30m = -1m 54s·468 + s·016

W	620	23 06 14·53	-·03	-·09	-·16	-·16	-·02 14·71	23 04 19·98	1 54·73		·04
	φ Aquarii	11 16·08	-·02	-·24	-·15	-·14	-·02 16·09	09 21·44		·65	·12
	γ Toucani	13 44·05	-·04	-·58	-·15	-·14	-·04 44·84	11 50·18		·66	·11
	621	39 39·79	-·02	·12	-·15	-·04	-·02 39·82	37 45·04		·78	-·01
	δ^1 Aquarii	41 08·53	-·03	·15	-·15	-·03	-·02 08·51	39 13·78		·73	·04
	622	45 50·66	·03	-·01	-·17	-·03	·02 50·80	43 55·91		·89	-·12
E	ι Ceti	24 00 44·77	-·06	·12	·15	-·04	·02 44·50	58 49·79		·71	·06
	33 Piscium	02 20·88	-·06	-·24	·15	·04	·02 20·49	24 00 25·83		·66	·11
	ζ Toucani	16 59·76	-·13	-·87	·35	·10	-·04 60·27	14 65·53		·74	·03
	44 Piscium	22 24·80	-·06	·31	·15	·12	-·02 24·26	20 29·47		·79	-·02
	339	27 04·24	-·06	·25	·15	·14	·02 03·74	25 08·88		·86	·09
	13 Baleine	32 14·26	-·06	·26	-·15	·15	·02 13·74	30 18·95		·79	·02
	130 Piazzi	34 20·44	-·07	·04	·16	·16	·02 20·13	32 25·27		·86	-·09

a = +s·609 c = -·146

Chronometer correction at 23h 50m = -1m 54s·770 - s·017

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND Date, October 12th, 1906. Observer, F. W. O. WERRY

Clamps.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Late.	Aberration.	Sum of corrections.	R. A.	Chronometer correction.
		h. m. s.	s.	s.	s.	s.	s.	s.	h. m. s.	m. s. s.
E	616	22 03 16 11	-·14	·11	·12	-·14	·02	16·14	22 01 15·24	2 00·90 ·02
	312	04 34 21	·09	·39	·13	·13	·02	33·89	02 33·08	·81 ·07
	314	07 22 76	-·12	·25	·12	·12	·02	22·61	05 21·69	·92 ·04
	α Toucani.	13 56 03	·25	·47	·25	·09	·04	56·55	11 55·69	·86 ·02
	317	18 43 12	·13	·20	·12	·07	·02	42·98	16 42·09	·89 -·01
	π Aquarii	22 [illegible]	·13	·22	·12	-·05	·02	23·62	20 22·74	·88 ·00
	320	32 [illegible]	·13	·21	·12	-·01	·02	26·61	30 25·69	·92 ·04
W	5 Grus	38 56 74	-·11	-·20	-·18	·02	·03	57·18	36 56·35	·83 ·05
	326	49 37 57	-·08	·16	·12	·06	·02	37·53	47 36·64	·89 ·01
	618	51 34 47	-·08	·10	·13	·07	·02	34·49	49 33·57	·92 -·04
	329	23 02 06 34	-·06	·31	-·12	·11	·02	00·08	59 59·27	·81 ·07
	620	06 20 90	-·06	·06	-·13	·13	·02	20·88	23 04 19·97	·91 -·03

a = -·440 c = ·121.

Chronometer correction at 22h 35m 2m 00s·877 = ·009.

W	φ Aquarii.	23 11 22 39	·03	·18	·18	-·30	·02	22·70	23 09 21·43	2 01·57 ·08
	γ Toucani	13 50 53	-·06	-·44	-·35	-·29	·04	51·66	11 50·17	·49 -·14
	3	24 10 19 65	-·03	·33	-·19	-·04	·02	19·56	24 08·18·21	·35 ·00
	ζ Toucani	17 05 62	·07	-·65	-·44	-·01	·04	06·75	15 05·51	·24 -·11
	44 Piscium.	22 30 87	·03	·23	-·18	·01	·02	30·82	20 29·48	·34 ·01
	339	27 10 32	·03	·19	-·18	·03	·02	10·29	25 08·88	·41 -·06
E	13 Baleine	32 20 54	·13	·19	-·18	·05	·02	20·23	30 18·95	·28 ·07
	540	40 18 31	·15	·09	-·19	·09	·02	48·07	38 46·72	·35 ·00
	11	44 17 78	-·10	·40	·20	-·11	·02	17·15	42 15·83	·32 ·03
	342	45 44 57	·12	·27	-·18	·12	·02	44·70	43 42·74	·36 -·01
	ζ¹ Piscium	25 10 45 56	-·12	-·27	-·18	-·22	·02	44·99	25 08·43·56	·43 -·08

a = -·461 c = -·182

Chronometer correction at 24h 20m 2m 01s·348 = ·019

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date, October 16th, 1903. Observer, L. W. O. WEEDY.

Clamp.	Star.	Transit over mean of threads.	Level and azimuth.	Azimuth.	Collimation.	Rate.	Weather.	R. A.	Chronometer correction.
		h m s	s	s	s	s	s	h m s	h m s	s
E	ζ Toucani	22 14 24 09	·10	·45	·50	·10	·04	23 29 22 11 55 58	2 27 71	·01
	317	19 10 08	·10	·19	·24	·09	·02	09 82 16 42 05	77	·05
	π Aquarii	22 50 69	·10	·21	·24	·08	·02	30 40 20 22 70	70	·02
	Aquarii	28 02 13	·11	·13	·25	·06	·02	01 90 25 34 19	71	·01
	39	32 53 72	·10	·27	·20	·07	·02	53 45 30 27 16	79	·07
	ε Gruis	39 24 05	·15	·19	·36	·05	·03	24 02 [illegible] 36 29	73	·01
	923	44 23 29	·07	·36	·37	·09	·02	22 71 41 55 02	69	·03
W	α Pegasi	47 50 54	·03	·36	·27	·01	·02	50 15 47 22 81	64	·08
	326	50 04 26	·05	·15	·27	·02	·02	04 37 47 36 62	72	·03
	618	52 01 07	·05	·16	·35	·02	·02	01 23 49 33 54	69	·03
	329	23 02 27 09	·04	·29	·27	·06	·02	27 01 50 59 24	77	·05
	620	56 47 53	·05	·07	·26	·07	·02	47 69 23 04 19 94	75	·03
	ν Aquarii	11 19 13	·05	·16	·35	·09	·02	19 16 00 21 46	76	·04
	γ Toucani	14 17 00	·08	·40	·47	·10	·04	17 87 11 50 46	71	·01

n = ·414 r = ·241

Chronometer correction at 22h 45m 2m 27s·723 ± ·008

W	534	23 24 28 98	·06	·31	·30	·14	·02	29 15	23 22 01 10	2 28 05	·07
	535	26 46 37	·05	·42	·31	·13	·02	46 42	24 18 52	27 90	·08
	538	50 04 94	·05	·49	·32	·05	·02	04 85	47 36 94	27 91	·07
	336	56 55 47	·06	·37	·31	·03	·02	51 48	54 23 44	28 04	·06
	ι Ceti	24 01 47 60	·07	·12	·32	·01	·02	17 86	58 49 78	28 08	·10
	33 Piscium	02 53 62	·06	·24	·31	·01	·02	53 74	24 00 25 82	27 92	·06
	3	10 46 31	·05	·44	·31	·02	·02	46 19	08 18 21	27 98	·00
E	ζ Toucani	17 33 11	·22	·89	·73	·04	·04	33 41	15 05 47	27 94	·04
	44 Piscium	22 58 02	·10	·32	·30	·06	·02	57 42	20 29 47	27 95	·03
	α Phœnicis	24 [illegible] 26	·15	·20	·41	·06	·03	01 05	21 32 97	28 08	·10
	339	27 [illegible] 43	·10	·26	·30	·07	·02	36 88	25 08 89	27 99	·01
	13 Baleine	32 47 54	·10	·36	·30	·09	·02	46 94	30 18 96	27 98	·00
	130 Piazzi	34 53 [illegible]	·13	·4	·34	·10	·02	53 29	32 25 28	28 01	·03
	342	46 11 [illegible]	·09	·47	·31	·14	·02	10 69	43 42 75	27 94	·04

n = ·304

Chronometer correction at 24h 05m 2m 27s·982 ± ·015

TRANSIT OBSERVATIONS.

Station: Sou'rupport. Date, September 25th, 1903. Observer: Otto Klotz.

Clamp.	Star.	Transit over mean of threads.	Level and in equality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Sum of last four cols.	R. A.	Chronometer correction.	L.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	α Aquarii.	20 46 55 57	·10	03	25	22	02 55 59		20 47 28 61	33 02	·01
	32 Vulpeculæ ..	49 55 83	06	00	28	19	02 55 60		50 28 06	32 97	·04
	θ Capricorni ...	21 00 00 14	10	02	28	14	02 00 08		21 00 33 13	33 05	·04
	c Cygni.. ..	08 18 91	06	00	29	·10	02 18 67		08 51 70	33 03	02
	α Equulei	10 28 95	·08	05	25	09	02 28 80		11 01 79	32 99	·02
W	ε Aquarii	25 57 55	19	04	25	·02	02 57 57		26 30 55	32 98	03
	. Aquarii. ...	32 05 74	19	03	25	02	02 05 73		32 38 73	33 00	01
	ε Pegasi	38 55 71	16	·06	25	05	02 55 67		39 28 68	33 01	·00
	α Tucani . .	22 11 22 99	·34	·10	52	22	04 23 01		22 11 56 06	33 05	·04

σ_{mean} = ·093 ·251

Chronometer correction at $21^h\ 28^m$ = 33s·010 ± ·00s

TRANSIT OBSERVATIONS

Station: SOUTHPORT. Date, September 2[illegible] 1909. Observer: [illegible]

Clamp	Star.	Transit overness of thread	Level correction	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of time transit.	L. A	Chronometer correction
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s. s.
E	γ Pavonis	20 36 16 05	·08	·68	·32	·40				
	ε Cygni	42 19 60	·02	·59	·18	·24	·05	17 13	20 36 18 15	·01 ·02
	α Aquarii	47 27 58	·01	·14	·13	·20	·03	18 98	42 20 17	·11
	ι Pisces Aust	55 23 00	·05	·04	·15	·17	·02	27 42	47 28 56	·19 ·06
	α Capricorni	21 00 32 03	·04	·08	·14	·11	·02	22 93	55 24 15	·14 ·01
	ε Aquarii	04 21 08	·04	·12	·13	·08	·02	31 83	21 00 33 08	·22 ·09
	ζ Cygni	08 51 14	·03	·42	·15	·05	·02	20 82	04 21 04	·25 ·12
W	γ Pavonis	18 20 16	·43	·66	·31	·03	·02	50 55	08 51 63	·12 ·01
	ζ Capricorni	21 10 42	·25	·04	·14	·04	·05	29 61	18 30 81	·08 ·05
	δ Aquarii	26 29 82	·21	·17	·13	·06	·02	10 19	21 11 28	·20 ·07
	ε Aquarii	32 37 94	·22	·16	·13	·00	·02	20 46	26 30 51	·09 ·04
	ε Pegasi	39 28 08	·18	·17	·13	·13	·02	37 55	32 38 69	·05 ·08
	δ Capricorni	41 14 09	·23	·09	·13	·18	·02	27 56	39 28 64	·14 ·01
	γ Gruis	48 06 15	·29	·10	·16	·19	·02	43 69	41 14 72	·08 ·05
						·24	·02	65 86	48 07 10	·03 ·10
										·24 ·11

ε ·637 ε ·129

Chronometer correction at 21h 12m 1·132 ·015

Clamp	Star.	Transit overness of thread	Level correction	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of time transit.	L. A	Chronometer correction
W	α Piscium	23 22 01 24	·13	·25	·10	·29	·02	01 23	23 22 01 26	·00 ·03 ·03
	ι Phœnicis	29 54 97	·19	·19	·13	·25	·02	55 32	29 55 14	·18 ·12
	ι Piscium	35 01 50	·12	·28	·10	·20	·02	01 38	35 01 30	·08 ·02
	β Sculptoris	43 55 99	·17	·01	·11	·15	·02	56 07	43 56 01	·06 ·00
	ω Piscium	54 23 76	·12	·29	·10	·08	·02	23 51	54 22 48	·03 ·03
	ι Ceti	58 49 91	·15	·09	·10	·05	·02	49 80	58 49 79	·01 ·05
	γ Pegasi	24 08 18 54	·11	·41	·10	·01	·02	18 09	24 08 18 23	·14 ·20
E	β Hydri	20 43 77	·48	1·85	·46	·09	·09	45 46	20 45 45	·01 ·05
	12 Ceti	25 09 34	·14	·21	·10	·13	·02	09 02	25 08 90	·12 ·06
	ε Andromedæ	33 30 59	·10	·19	·11	·18	·02	29 89	33 29 85	·04 ·02
	β Ceti	38 47 03	·16	·09	·10	·21	·02	46 77	38 46 72	·05 ·01
	δ Piscium	43 43 28	·13	·30	·10	·25	·02	42 74	43 42 65	·09 ·03
	20 Ceti	48 07 24	·14	·23	·10	·28	·02	06 75	48 06 61	·14 ·08
	μ Andromedæ	51 27 52	·08	·60	·12	·29	·02	26 57	51 26 56	·01 ·05

ε ·513 ε ·097

Chronometer correction at 24h 06m ·056 ·015

TRANSIT OBSERVATIONS.

Station : SOUTHPORT. Date, September 30th, 1903. Observer : OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and in equality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	v.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	β Pavonis..	20 36 27·98	+·04	+·68	·17	+·26	·05	28·74	20 36 18·46	10·28	·04
	ε Cygni	42 30·80	+·01	·46	·08	+·21	·02	30·46	42 20·15	·31	·01
	α Aquarii	47 38·93	+·02	·14	·07	+·17	·02	38·89	47 28·54	·35	·03
	ι Piscis Aust ..	55 34·45	+·03	+·04	·08	+·11	·02	34·53	55 24·11	·39	·07
	ν Aquarii... .	21 04 32·39	+·02	·12	·07	+·04	·02	32·24	21 04 21·92	·32	·00
	ζ Cygni.. ..	09 02·15	+·02	·42	·08	·00	·02	01·95	08 51·63	·32	·00
W	γ Pavonis.. ...	18 40·77	·36	+·65	+·16	·07	·05	41·10	18 30·78	·32	·00
	ζ Capricorni	21 21·87	·29	·04	·07	·09	·02	21·59	21 11·27	·32	·00
	β Aquarii	26 41·21	·17	·16	+·07	·13	·02	40·80	26 30·50	·30	·02
	ε Aquarii	32 49·50	·17	·15	+·07	·18	·02	49·05	32 38·68	·37	+·05
	ε Pegasi	39 35·51	·15	·27	+·07	·24	·02	38·90	39 28·63	·27	·05
	δ Capricorni ...	41 55·48	·19	·09	+·07	·26	·02	54·99	41 44·71	·28	·04

a = +·436 c = ·067

Chronometer correction at $21^h\ 09^m$ 10s·319 + ·008

TRANSIT OBSERVATIONS.

Station : SOUTHPORT. Date, October 1st, 1903. Observer : OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and in equality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	v.
		h. m. s.	s.	s.	s.	s.	s.	s.	h. m. s.	s.	s.
E	α² Aquarii.. ...	23 04 43·82	·03	·05	·15	+·40	·02	43·97	23 04 20·06	23·91	+·02
	γ Toucani.. ...	12 13·81	·05	+·40	·26	+·31	·04	14·17	11 50·31	·86	·03
	τ Pegasi	16 18·02	·02	·35	·15	+·28	·02	17·76	15 53·91	·85	·04
	κ Piscium. . .	22 25·22	·03	·20	·14	·24	·02	25·07	22 01·20	·87	·02
	ι Phenicis. ...	30 19·04	·04	+·15	·19	+·17	·03	19·10	29 55·13	·97	+·08
	ε Piscium . .	35 25·43	+·03	+·22	·14	+·12	·02	25·14	35 01·32	·82	·07
	δ Sculptoris....	44 20·03	·03	·00	·16	·04	·02	19·86	43 55·96	·90	+·01
W	ω Piscium . .	54 47·52	+·01	·23	+·14	·04	·02	47·38	54 23·49	·89	·00
	γ Pegasi..	24 08 42·45	+·01	·29	+·14	·15	·02	42·14	24 08 18·24	·90	+·01
	ι Ceti	14 56·78	+·01	·13	+·14	·22	·02	56·56	14 32·68	·88	·01
	β Hydri . .	21 07·52	+·03	+1·48	+·65	·28	·09	09·31	20 45·43	·88	·01
	12 Ceti	25 33·21	+·01	·16	+·14	·31	·02	32·87	25 08·90	·97	·08
	ε Andromedæ..	33 54·36	+·01	·39	+·16	·40	·02	53·72	33 29·86	·86	·03

a = ·409 c = ·137

Chronometer correction at $23^h\ 49^m$ 23s·8 + ·009

TRANSIT OBSERVATIONS.

Station: SOUTHPORT.

Date, October 2nd, 1903.

Observer: OTTO KLOTZ

Clamp.	Star.	Transit over mean of threads	Level and equality in pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	μ Aquarii	20 48 03·00	·01	·15	·16	r ·596					
	32 Vulpeculæ	51 03·22	·00	·45	·18	·37	·02	03·03	20 47 28·51	34·52	·08
	1 Piscis Aust.	55 58·45	·01	·05	·19	·34	·02	02·91	50 28·54	·37	·07
	θ Capricorni	21 01 07·50	·01	·09	·16	·30	·02	58·58	55 24·11	·47	·03
	ν Aquarii	04 56·49	·01	·14	·16	·24	·02	07·46	21 00 33·04	·42	·02
	γ Pavonis	19 04·78	·02	·73	·38	·06	·05	56·37	04 21·89	·48	·04
W	ϑ Aquarii	27 05·35	·32	·18	·16	·02	·02	05·12	18 30·70	·42	·02
	ε Pegasi	40 03·46	·19	·30	·16	·15	·02	04·97	26 30·48	·49	·05
	δ Capricorni	42 19·53	·25	·10	·16	·17	·02	02·96	39 28·60	·36	·08
	α Aquarii	22 01 26·61	·22	·22	·16	·36	·02	19·15	41 44·69	·46	·02
	α Gruis	02 45·92	·35	·24	·23	·37	·03	25·95	22 00 51·50	·45	·01
								15·54	02 11·29	·44	·00

a ·484 c ·156

Chronometer correction at 21h 25m 34s·442 ·012

W	α Pegasi	23 00 34·96	·05	·30	·07	·54	·02	35·30	22 59 59·36	35·94	·01
	ω Aquarii	04 55·47	·07	·05	·07	·50	·02	56·04	23 04 20·06	·98	·03
	τ Pegasi	16 29·73	·04	·36	·08	·38	·02	29·85	15 53·91	·94	·01
	κ Piscium	22 36·87	·06	·20	·07	·32	·02	37·10	22 01·19	·91	·04
	ι Phœnicis	30 30·60	·16	·16	·09	·24	·03	31·16	29 55·13	36·03	·08
	ι Piscium	35 37·14	·06	·23	·07	·19	·02	37·21	35 01·30	35·91	·04
	δ Sculptoris	44 31·70	·07	·00	·08	·10	·02	31·93	43 56·01	·92	·03
E	α Andromedæ	24 04 02·98	·06	·40	·08	·10	·02	02·44	24 03 26·44	36·00	·05
	ι Ceti	15 08·99	·09	·14	·07	·21	·02	08·64	14 32·68	35·96	·01
	ϑ Hydri	21 20·24	·29	1·53	·33	·27	·02	21·37	20 45·44	·93	·02
	12 Ceti	25 45·35	·09	·17	·07	·31	·02	44·87	25 08·90	·97	·02
	ε Andromedæ	34 06·62	·06	·40	·08	·40	·02	05·78	33 29·87	·91	·04
	δ Piscium	44 19·39	·08	·25	·07	·50	·02	18·63	43 42·67	·96	·01
	20 Ceti	48 43·31	·09	·19	·07	·54	·02	42·58	48 06·63	·95	·00

a ·424 c ·069

Chronometer correction at 23h 54m 35s·952 ·007

TRANSIT OBSERVATIONS.

Station: SOUTHPORT. Date, October 3rd, 1903. Observer: OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and unequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	c.
		h. m. s.	s.	s.	s.	s. r 49	s.		h. m. s.	s.	s.
E	α Pavonis	20 18 49·96	·07	·70	·25	-·34	04	50·38	20 17 62·78	47·60	·01
	α Indi	31 36·00	-·06	·17	·20	-·23	03	36·23	30 48·50	·73	-·12
	α Delphini	35 58·67	·03	·24	·14	-·20	02	58·50	35 10·87	·63	-·02
	ε Cygni	43 08·01	-·03	·36	·16	·14	03	07·63	42 20·09	·54	·07
	θ Capricorni	21 01 20·73	-·05	·06	·14	·01	02	20·55	21 00 33·03	·52	·09
	ν Aquarii	05 09·73	·04	·10	·14	·04	·02	09·47	04 21·88	·59	·02
W	γ Pavonis	19 17·62	·07	·50	·33	·15	05	18·18	18 30·67	·51	·10
	ζ Capricorni	21 58·97	·04	·03	-·15	·17	02	58·86	21 11·23	·63	-·02
	β Aquarii	27 18·34	·03	·12	-·14	·21	02	18·10	26 30·46	·64	-·03
	ξ Aquarii	33 26·65	·04	·12	-·14	·27	02	26·34	32 38·65	·69	-·08
	ε Pegasi	40 16·71	·03	·21	·14	·32	02	16·27	39 28·59	·68	-·07
	δ Capricorni	42 32·65	·04	·07	·14	·34	02	32·32	41 44·68	·64	-·03

a = -·340 c = ·136

Chronometer correction at 21h 00m = 47·615 ± ·015

W	σ Aquarii	22 26 22·71	·04	·13	-·11	·37	02	23·00	22 25 34·32	48·68	·00
	η Aquarii	31 14·31	·04	·20	-·11	-·33	02	14·49	30 25·79	·70	-·02
	β Gruis	37 44·63	·06	-·22	·16	-·28	03	45·20	36 56·47	·73	·05
	η Pegasi	39 19·82	·03	·43	-·12	·26	·02	19·72	38 30·99	·73	-·05
	ε Gruis	43 33·77	·06	-·29	·17	-·24	·03	34·38	42 45·78	·60	·08
	α Pegasi	23 00 48·17	·03	·31	-·11	-·09	02	48·01	59 59·36	·65	-·03
E	γ Toucani	12 38·54	·33	-·43	·21	·01	·04	39·04	23 11 50·29	·75	·07
	κ Piscium	22 50·12	·17	·21	·11	·09	02	49·86	22 01·19	·67	·01
	ι Piscium	35 50·35	-·17	·24	·11	·20	02	49·95	35 01·30	·65	·03
	δ Sculptoris	44 44·81	·21	·00	·12	·27	02	44·61	43 56·01	·60	·08
	φ Pegasi	48 26·31	-·14	·34	·11	·30	02	25·68	47 36·98	·70	-·02
	ω Piscium	55 12·71	-·16	·25	·11	·37	02	12·12	54 23·48	·64	·04

a = -·439 c = ·108

Chronometer correction at 23h 11m = -48·676 ± ·012

TRANSIT OBSERVATIONS.

Station: SOUTHPORT. Date, October 6th, 1903. Observer: OTTO KLOTZ

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
E	θ Aquilæ	20 07 40·87	00	15	10	40					
	α² Capricorni	14 03 39	00	·09	10	19	02 40 79		20 06 20 84	1 19 95	01
	β Capricorni	16 56 69	00	08	10	15	·02 03 33		12 43 40	93	01
	α Pavonis	19 22 45	00	·29	18	13	·02 56 62		15 36 76	86	08
	ρ Capricorni	24 42 83	00	06	10	11	04 22 63		18 02 69	94	00
	ι Delphini	29 57 81	00	·21	10	08	02 42 73		23 22·83	·90	04
	α Indi	32 08 42	00	·16	15	05	02 57 53		28 37 58	95	01
W	β Pavonis	37 37 79	39	51	25	03	03 08 43		30 48 43	20 00	06
	ι Cygni	43 40 39	·11	35	12	01	05 38 10		36 18 20	19 90	04
	α Aquarii	48 48 79	19	11	10	05	02 39 98		42 20 03	95	·01
	32 Vulpeculæ	51 48 85	13	31	11	08	02 48 49		47 28 45	20 04	·10
	1 Piscis Aust.	56 44 26	24	03	12	10	02 48 40		50 28 48	19 92	·02
	θ Capricorni	21 01 53 22	21	06	10	13	02 44 02		55 24 04	98	·04
	π Aquarii	05 42 22	20	09	10	17	02 52 86		21 00 32 99	87	07
						19	02 41 82		04 21 84	98	04

a = ·330 c = ·090

Chronometer correction at 20h 36m 1m 19·942 ·010

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	
W	α Piscis Aust.	22 53 42 04	13	01	10	·29	·02 42 29		22 52 21 09	1 21 20	05
	α Pegasi	23 01 20·47	09	25	09	24	02 20 44		59 59 34	10	05
	γ Toucani	13 10 97	19	35	16	16	·04 11·41		23 11 50 26	15	00
	τ Pegasi	17 15 16	08	30	09	13	02 14 98		15 53·90	·08	07
	κ Piscium	23 22 42	10	17	08	·09	·02 22 30		22 01 18	12	03
	ι Phœnicis	31 16 22	15	13	·11	04	03 16 32		29 55 11	21	·06
	ι Piscium	36 22 62	10	20	08	01	02 22 39		35 01 29	10	05
E	δ Sculptoris	45 17 12	14	00	09	05	02 17 10		43 56 00	10	05
	ω Piscium	55 44 98	10	20	08	·12	02 44 66		54 23 50	·16	·01
	2 Ceti	24 00 11 16	·13	·06	·09	15	02 10 97		58 49 80	17	02
	α Andromedæ	04 48 23	·08	34	09	18	02 47 68		24 03 26 45	23	·08
	γ Pegasi	09 39 86	·09	25	09	21	02 39 38		08 18 24	·14	01
	ι Ceti	15 54 21	·12	11	08	25	02 53 87		14 32·69	18	03
	β Hydri	22 05 68	37	·1 28	39	29	09 06 56		20 45·43	13	02

a = ·355 c = ·083

Chronometer correction at 23h 37m 1m 21·148 ·009

TRANSIT OBSERVATIONS.

Station : SOUTHPORT. Date, October 7th, 1903. Observer : OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	r.
		h. m. s.	s.	s.	s.	s. r = − ·35	s.		h. m. s.	m. s.	s.
E	ξ Aquarii. ..	21 34 09·63	+ ·17	·13	− ·08	+ ·26	− ·02	09·83	21 32 38·60	1 31·23	− ·02
	ε Pegasi ..	40 59·74	− ·14	·23	·08	+ ·22	− ·02	59·77	39 28·54	·23	− ·02
	δ Capricorni .	43 15·61	18	− ·08	·08	+ ·20	·02	15·81	41 44·63	·18	·03
	γ Gruis ..	49 37·87	·22	− ·08	·10	+ ·17	·03	38·21	48 06·97	·24	− ·03
	α Aquarii.	22 02 22·71	16	·17	·08	+ ·09	·02	22·69	22 00 51·45	·24	− ·03
	ι Pegasi	04 04·52	12	·33	·08	+ ·08	·02	04·29	02 33·14	15	·06
W	η Pegasi	40 02·65	− ·07	·36	− ·09	13	·02	02·16	38 30·96	·20	·01
	ε Gruis . .	44 16·85	·16	− ·24	+ ·12	− ·15	·03	16·87	42 45·72	15	·06
	α Pegasi ...	46 54·66	− ·07	·32	− ·08	− ·16	·02	54·17	45 22·90	·27	− ·06
	λ Aquarii.	49 08·27	·10	·13	− ·08	·18	·02	07·92	47 36·74	·18	·03
	δ Aquarii. .	51 05·19	− ·11	− ·08	− ·08	·19	·02	04·87	49 33·65	·22	− ·01
	α Piscis Aust ...	53 52·60	·13	− ·01	− ·09	·20	·02	52·35	52 21·08	·27	− ·06
	α Pegasi	23 01 31·07	·08	·26	− ·08	·26	·02	30·53	59 59·34	·19	·02

a = + ·372 c = − ·077

Chronometer correction at $22^h\ 18^m$ = $1^m\ 31·215$ − ·010

W	δ Sculptoris ..	23 45 27·83	− ·16	·00	+ ·18	+ ·20	·02	28·03	23 43 55·95	1 32·08	·08
	φ Pegasi	49 09·09	− ·10	− ·35	+ ·16	+ ·17	·02	08·95	47 36·98	31·97	− ·03
	ω Piscium	55 55·63	− ·11	− ·26	+ ·16	+ ·14	·02	55·54	54 23·50	32·04	− ·04
	2 Ceti	24 00 21·82	− ·14	− ·08	+ ·16	− ·11	·02	21·85	58 49·80	32·05	− ·05
	α Andromedæ .	04 58·68	− ·08	·43	+ ·18	+ ·09	·02	58·42	24 03 26·45	31·97	·03
	γ Pegasi .. .	09 50·42	− ·10	− ·32	+ ·16	+ ·06	− ·02	50·20	08 18·25	31·95	·05
	ζ Toucani .	16 36·79	− ·27	+ ·66	− ·37	+ ·02	·05	37·52	15 05·55	31·97	·03
E	ϑ Hydri	22 16·05	− ·58	+ 1·64	·73	− ·02	·09	17·43	20 45·42	32·01	− ·01
	12 Ceti .. .	26 41·17	− ·17	·18	− ·15	− ·04	·02	40·95	25 08·93	32·02	− ·02
	ε Andromedæ ..	35 02·37	− ·12	− ·43	·18	− ·09	− ·02	01·77	33 29·89	31·88	·12
	ϑ Ceti . ..	40 18·97	− ·20	·08	− ·16	·12	·02	18·79	38 46·76	32·03	− ·03
	δ Piscium .	45 15·23	− ·14	·26	·16	− ·15	·02	14·78	43 42·70	32·08	− ·08
	20 Ceti ..	49 39·09	− ·17	·20	·15	·18	·02	38·71	48 06·65	32·06	− ·06
	α Andromedæ .	52 59·45	− ·10	·52	·20	·20	·03	58·60	51 26·63	31·97	·03

a = + ·455 c = − ·155

Chronometer correction at $24^h\ 19^m$ $1^m\ 32·005$ − ·012

TRANSIT OBSERVATIONS.

Station: SOUTHPORT. Date, October 8th, 1903. Observer: OTTO KLOTZ

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
E	β Pavonis	20 37 59·55	·27	·59	·27	r = ·50					
	ε Cygni.. ...	44 02·43	·08	·40	·13	·35	·05	60·44	20 36 18·11	1 42·33	·03
	α Aquarii.	49 10·58	·13	·12	·11	·30	·02	02·26	42 19·09	·27	·03
	32 Vulpeculæ....	52 10·88	·09	·35	·12	·26	·02	10·72	47 28·42	·30	·00
	i Piscis Aust...	57 06·03	·16	·04	·13	·23	·02	10·71	50 28·44	·27	·03
	θ Capricorni....	21 02 15·16	·15	·07	·11	·19	·02	06·27	55 24·01	·26	·04
	ν Aquarii	06 04·07	·14	·11	·11	·15	·02	15·26	21 00 32·96	·30	·00
						·12	·02	04·09	04 21·81	·28	·02
W	γ Pavonis	20 12 25	·31	·57	·26	·00	·05	12·72	18 30·49	·23	·07
	ζ Capricorni....	22 53·66	·17	·04	·12	·02	·02	53·53	21 11·19	·34	·04
	β Aquarii	28 12·99	·15	·14	·11	·07	·02	12·72	26 30·40	·32	·02
	ξ Aquarii	34 21·17	·15	·13	·11	·12	·02	20·86	32 38·58	·28	·02
	ε Pegasi	41 11·28	·13	·24	·11	·17	·02	10·83	39 28·53	·30	·00
	γ Gruis.....	49 49·57	·20	·08	·13	·24	·03	49·31	48 06·96	·35	·05
	α Aquarii	22 02 34·32	·14	·17	·11	·35	·02	33·75	22 00 51·44	·31	·01

a = ·380 c = ·106

Chronometer correction at 21h 20m = −1m 42s·296 ± ·007

W	α Toucani . ..	22 13 38·20	·21	·44	·22	·49	·04	39·10	22 11 55·80	1 43·30	·08
	η Pegasi . ..	40 14·24	·07	·38	·13	·27	·02	14·17	38 30·95	·22	·00
	α Pegasi	47 06·21	·08	·34	·12	·21	·02	06·10	45 22·90	·20	·02
	λ Aquarii.	49 19·92	·11	·13	·11	·19	·02	19·96	47 36·73	·23	·01
	δ Aquarii.....	51 16·81	·12	·08	·11	·17	·02	16·87	49 33·64	·23	·01
	α Piscis Aust...	54 04·21	·14	·02	·13	·15	·02	04·35	52 21·07	·28	·06
	α Pegasi.	23 01 42·76	·09	·27	·11	·09	·2	42·58	59 59·33	·25	·13
E	γ Toucani	13 32·90	·35	·39	·21	·01	·04	33·38	23 11 50·24	·14	·08
	ι Piscium .	36 44·91	·17	·22	·11	·20	·02	44·53	34 61·29	·24	·02
	φ Pegasi	49 20·83	·16	·30	·11	·31	·02	20·25	47 36·98	·27	·05
	ω Piscium ..	56 07·27	·17	·22	·11	·37	·02	06·72	54 23·49	·23	·01
	τ Ceti.....	24 00 33·35	·22	·07	·11	·40	·02	32·97	58 49·80	·17	·05
	α Andromedæ ..	05 10·47	·13	·37	·12	·44	·02	09·65	24 03 26·45	·20	·02
	γ Pegasi...	10 02·13	·16	·27	·11	·49	·02	01·40	08 18·25	·15	·07

a = ·392 c = ·109

Chronometer correction at 23h 12m = 1m 43s·219 ± ·010

TRANSIT OBSERVATIONS.

Station: SOUTHPORT. Date, October 9th, 1903. Observer: OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	c.
		h. m. s.	s.	s.	s.	r = s. ·48	s.		h. m. s.	m. s.	s.
E	β Pavonis	20 38 11·49	·31	·60	·27	·29	·05	12·37	20 36 18·09	1 54·28	·06
	ε Cygni	45 14 40	·09	·40	·15	·23	·02	14·17	42 19·97	·20	·02
	μ Aquarii	49 22·51	·15	·12	·11	·20	·02	22·61	47 28·41	·20	·02
	32 Vulpeculæ	52 22·86	·10	·36	·12	·18	·02	22·64	50 28·42	·22	·00
	1 Piscis Aust.	57 17·94	·19	·04	·13	·14	·02	18·16	55 23·99	·17	·05
	θ Capricorni	21 02 27·04	·16	·07	·12	·10	·02	27·09	21 00 32·94	·15	·07
	ν Aquarii	06 16·06	·16	·11	·11	·06	·02	16·04	04 21·79	·25	·03
W	γ Pavonis	20 24·15	·31	·58	·27	·05	·05	24·59	18 30·45	·14	·08
	ζ Capricorni	23 05·57	·17	·04	·12	·07	·02	05·39	21 11·15	·24	·02
	β Aquarii	28 24·88	·15	·15	·11	·11	·02	24·56	26 30·39	·17	·05
	ξ Aquarii	34 33·24	·15	·13	·11	·16	·02	32·89	32 38·57	·32	·10
	ε Pegasi	41 23·25	·13	·24	·11	·22	·02	22·75	39 28·52	·2	·01
	δ Capricorni	43 39·21	·16	·08	·11	·23	·02	38·83	41 44·60	·23	·01
	γ Gruis	50 01·50	·20	·08	·14	·29	·03	01·20	48 06·95	·25	·03

$a = +^s·386$ $c = -^s·110$

Chronometer correction at $21^h\ 14^m$ = $1^m\ 54^s·217$ ·009

TRANSIT OBSERVATIONS.

Station: SOUTHPORT. Date, October 10th, 1903. Observer: OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	c.
		h. m. s.	s.	s.	s.	r = s. ·50	s.		h. m. s.	m. s.	s.
E	β Pavonis	20 38 23·42	+·30	+·56	·36	+·30	·05	24·17	20 36 18·06	2 06·11	·01
	ε Cygni	44 26·29	+·09	−·38	·17	+·25	·02	26·06	42 19·95	·11	·01
	μ Aquarii	49 34·43	+·15	−·12	·14	+·21	·02	34·51	47 28·40	·11	·01
	32 Vulpeculæ	52 34·75	+·10	−·34	·16	+·18	·02	34·51	50 28·40	·11	·01
	1 Piscis Aust.	57 29·90	+·18	+·04	·16	+·14	·02	30·08	55 23·97	·11	·01
	θ Capricorni	21 02 38·95	+·16	−·07	·14	+·10	·02	38·98	21 00 32·93	·05	·05
	ν Aquarii	06 27·92	+·15	−·10	·14	·06	·02	27·87	04 21·78	·09	·01
W	γ Pavonis	0 35·98	·27	+·54	+·34	·05	−·05	36·49	18 30·41	·08	·02
	ζ Capricorni	23 17·36	+·15	−·04	+·15	·07	−·02	17·23	21 11·14	·09	·01
	β Aquarii	28 36·73	+·13	−·14	+·14	·12	−·02	36·46	26 30·38	·08	·02
	ξ Aquarii	34 44·96	+·13	·12	+·14	·17	−·02	44·66	32 38·56	·10	·00
	ε Pegasi	41 35·07	+·11	·22	+·14	+·23	−·02	34·63	39 28·50	·13	·03
	δ Capricorni	43 51·03	+·14	·08	+·14	−·24	−·02	50·67	41 44·59	·08	·02
	γ Gruis	50 13·34	+·17	−·08	+·18	·30	−·03	13·10	48 06·93	·17	·07

$a = +^s·362$ $c = -^s·138$

Chronometer correction at $21^h\ 14^m$ = $2^m\ 06^s·102$ $-^s·005$

TRANSIT OBSERVATIONS.

Station: SOUTHPORT. Date, October 11th, 1903. Observer: OTTO KLOTZ

Clamp.	Star.	Transit over mean of threads.	Level and in equality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of arc.	R. A.	Chronometer correction.	v.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
E	μ Capricorni...	20 25 39·44	·09	·06	·11	·44	·02	39 57	20 23 22·74	2 16·83	·04
	ε Delphini.....	30 54 39	·07	·23	·11	·19	·02	54 29	28 37 50	·79	·00
	γ Pavonis.....	38 34 26	·16	·56	·27	·14	·05	34 80	36 18 00	·80	·01
	τ Cygni.....	44 37 09	·05	·38	·13	·10	·02	36 71	42 19 92	·79	·00
	π Aquarii....	49 45 26	·08	·11	·11	·06	·02	45 16	47 28 38	·78	·01
	β^2 Vulpeculæ....	52 45 50	·05	·33	·12	·04	·02	45 12	50 28 38	·74	·05
	ψ Piscis Aust.	57 40 73	·10	·04	·13	·00	·02	40 72	55 23 95	·77	·02
W	θ Capricorni...	21 02 49·83	·16	·06	·11	·04	·02	49 66	21 00 32·91	·75	·04
	ν Aquarii.....	06 38·83	·16	·10	·11	·06	·02	38 60	04 21 76	·84	·05
	ζ Cygni.....	11 08·70	·10	·35	·12	·11	·02	08 24	08 51 44	·80	·01
	α Equulei...	13 18·72	·13	·19	·11	·11	·02	18·38	11 01 58	·80	·01
	γ Pavonis....	20 46·87	·31	·54	·26	·16	·05	47 15	18 30·37	·78	·01
	ζ Capricorni...	23 28·23	·17	·04	·12	·19	·02	27·93	21 11 12	·81	·02
	ψ Aquarii.....	28 47·57	·15	·14	·11	·23	·02	47 14	26 30 36	·78	·01

$a = -{}^s{}^{\cdot}357 \quad c = +{}^s{}^{\cdot}166$

Chronometer correction at $2^{h}\,57^{m}$ $2^m\,16^s{}^{\cdot}789 - {}^s{}^{\cdot}005$

W	ε Pegasi.....	21 41 45·86	·13	·19	·09	·34	·02	45 95	21 39 28 49	2 17·46	·01
	δ Capricorni....	44 01·87	·16	·06	·10	·32	·02	02·05	41 44 58	·47	·00
	γ Gruis.....	50 24 17	·19	·07	·12	·28	·03	24 42	48 06 91	·51	·04
	α Aquarii...	22 03 08 91	·14	·14	·09	·19	·02	08 89	22 00 51·41	·48	·01
	ι Pegasi.....	04 50·62	·10	·26	·10	·17	·02	50 51	02 33 09	·42	·05
	α Toucani.....	14 12·86	·26	·33	·19	·10	·04	13·18	11 57 72	·46	·01
E	ε Gruis.....	45 03·04	·17	·19	·15	·13	·03	03 09	42 45 64	·45	·02
	δ Aquarii.....	51 51 28	·12	·06	·10	·16	·02	51 06	49 33 62	·44	·03
	α Piscis Aust...	54 38·68	·13	·01	·11	·18	·02	38·51	52 21 04	·47	·00
	α Pegasi.....	23 02 17·29	·08	·21	·10	·25	·02	16 79	59 59·31	·48	·01
	σ^2 Aquarii....	06 37·78	·12	·04	·10	·27	·02	37·47	23 04 20 01	·49	·01
	γ Toucani....	14 07·73	·19	·30	·18	·34	·04	07·66	11 50 18	·48	·01

$a = -{}^s{}^{\cdot}298 \quad c = +{}^s{}^{\cdot}093.$

Chronometer correction at $22^{h}\,28^{m}$ $2^m\,17^s{}^{\cdot}466 - {}^s{}^{\cdot}005$

TRANSIT OBSERVATIONS.

Station: SOUTHPORT. Date, October 12th, 1903. Observer: OTTO KLOTZ.

Change.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of over transit.	R. A.	Chronometer correction.	c.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
E	β Pavonis	20 38 46 06	-·06	-·55	·22	+·19	·05	46 59	20 36 17 96	2 28 63	·06
	ε Cygni	44 48 72	+·02	·37	·10	+·16	·02	48 41	42 19 90	·51	·06
	α Aquarii	49 56 98	+·03	·11	·09	+·12	·02	56 91	47 28 36	·55	·02
	32 Vulpeculæ	52 57 17	+·02	·33	·10	+·11	·02	56 85	50 28 36	·49	·08
	ι Piscis Aust.	57 52 49	+·04	-·04	·10	+·08	·02	52 53	55 23 93	·60	-·03
	θ Capricorni	21 03 01 50	+·03	·07	·09	+·04	·02	01 39	21 00 32 89	·50	·07
	ν Aquarii	06 50 48	+·03	·10	·09	+·02	·02	50 32	04 21 75	·57	·09
W	ζ Cygni	11 20 46	·14	·34	+·10	·01	·02	20 08	08 51 42	·66	+·09
	α Equulei	13 30 46	·16	·19	+·09	·02	·02	30 16	11 01 55	·61	+·04
	γ Pavonis	20 58 53	·37	-·53	+·21	·06	·05	58 79	18 30 33	·46	·11
	ζ Capricorni	23 39 92	·20	·04	+·09	·08	·02	39 67	21 11 10	·57	·00
	δ Aquarii	28 59 27	·17	·13	+·09	·11	·02	58 93	26 30 35	·58	+·01
	ξ Aquarii	35 07 53	-·18	·13	+·09	·15	·02	07 14	32 38 53	·61	+·04
	ε Pegasi	41 57 56	·15	·22	+·09	·19	·02	57 07	39 28 48	·59	+·02

a = -0·354 c = -0·086

Chronometer correction at $21^h\ 10^m$ $2^m\ 28^s·565$ +·012

W	δ Capricorni	21 44 13 52	-·16	·06	+·06	+·25	·02	13 59	21 41 44 56	2 29 03	·02
	γ Gruis	50 35 89	-·19	+·06	+·08	+·21	·03	36 02	46 06 89	·13	+·08
	α Aquarii	22 03 20 55	-·14	·13	+·06	+·13	·02	20 45	22 00 51 40	·05	·00
	ι Pegasi	05 02 31	·10	-·24	+·07	+·12	·02	02 14	02 33 07	·07	+·02
	α Toucani	14 24 51	-·27	+·31	+·13	+·07	·04	24 71	14 55 69	·02	·03
	γ Aquarii	19 11 36	·14	·12	+·06	+·04	·02	11 18	16 42 13	·05	·00
E	μ Pegasi	47 52 35	+·08	-·24	·07	·13	·02	51 97	45 22 86	·11	+·06
	λ Aquarii	50 05 92	+·11	+·09	·06	·15	·02	05 71	47 36 70	·01	+·04
	δ Aquarii	52 02 88	+·12	·06	+·06	·16	-·02	02 70	49 33 61	·09	+·04
	α Piscis Aust.	54 50 16	+·14	+·01	·07	·17	·02	50 05	52 21 03	·02	+·03
	e^2 Aquarii	23 06 49 20	+·12	·03	·07	·25	·02	48 95	23 04 20 00	28 95	·10
	γ Toucani	14 19 27	+·19	+·27	·12	·29	·04	19 28	11 50 17	29 11	+·06

a = -0·277 c = -0·062

Chronometer correction at $22^h\ 25^m$ = $2^m\ 29^s·053$ + ·011

TRANSIT OBSERVATIONS.

Station: SOUTHPORT. Date, October 13th, 1903. Observer: OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s. s.
E	ε Gruis	22 45 25 39	16	23	04	13	53	25 84	22 42 45 57	2 40 25 04
	α Pegasi	48 03 26	07	31	03	11	02	03 08	45 22 85	23 00
	λ Aquarii	50 16 83	10	12	03	09	02	16 85	47 36 69	16 07
	δ Aquarii	52 13 78	11	07	03	08	02	13 85	49 33 60	25 02
	α Piscis Aust	55 01 07	13	01	03	06	02	01 22	52 21 02	20 03
W	α Pegasi	23 02 39 79	08	25	03	02	02	39 49	59 59 29	20 03
	α² Aquarii	07 00 41	12	04	03	01	02	00 25	23 04 19 99	26 03
	γ Toucani	14 30 24	19	35	05	05	04	30 36	11 50 15	21 02
	τ Pegasi	18 34 58	08	30	03	08	02	34 13	15 53 86	25 04
	κ Piscium	24 41 79	10	17	03	13	02	41 10	22 01 15	25 02

a = ·355 c = ·025

Chronometer correction = ·39 069 = 2m 40s 229 = ·009

TRANSIT OBSERVATIONS.

Station: SOUTHPORT. Date, October 15th, 1903. Observer: OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s. s.
E	γ Gruis	21 51 10 11	·04	·07	·13	35	03	10 41	21 48 06 85	3 03 56 00
	α Toucani	22 14 58 95	·06	·34	·21	18	04	59 28	22 11 55 61	67 11
	γ Aquarii	19 45 73	+·03	·18	10	14	02	45 65	16 42 09	56 00
	σ Aquarii	28 37 74	·04	·09	·10	07	·02	37 64	25 34 20	44 12
	η Aquarii	33 29 43	·03	14	·10	04	02	29 16	30 25 68	48 08
W	α Piscis Aust	55 24 76	17	·01	·12	·13	02	24 57	52 21 00	57 01
	α Pegasi	23 03 03 32	11	21	·10	19	02	02 89	59 59 28	61 05
	γ Toucani	14 53 65	25	30	·19	27	04	53 58	23 11 50 11	17 09
	τ Pegasi	18 57 59	·10	26	·11	30	02	57 42	15 53 84	58 02
	κ Piscium	25 05 28	13	·15	·10	35	02	04 73	22 01 07	66 10

a = ·305 c = ·100

Chronometer correction = + 22s 38m = 3m 03s 561 = ·019

TRANSIT OBSERVATIONS.

Station: SOUTHBOIS. Date, October 16th, 1905. Observer: OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and collimation equations in seconds.	Azimuth.	Collimation.	Rate.	Variation.	Personal equation of transit.	R. A.	Chronometer correction.
		h. m. s.	s.	s.	s.	s.	s.	s.	h. m. s.	m. s.
E	β Capricorni	20 18 50 73	17	00	11	27	0	95	20 15 36 62	3 14 33 02
	ρ Capricorni	26 36 79	17	07	12	21	02	36 86	23 22 65	31 00
	ε Delphini	31 51 78	13	24	11	17	02	51 71	28 37 41	30 01
	δ Pavonis	39 31 36	33	50	28	12	05	32 07	36 17 73	34 03
	ε Cygni	45 34 45	49	40	13	07	02	34 06	42 19 82	24 07
	ω Aquarii	50 42 68	16	12	11	03	02	42 62	47 28 30	32 01
	32 Vulpeculæ	53 42 92	11	35	12	01	02	42 55	50 28 29	26 05
W	θ Capricorni	21 03 47 37	16	07	12	07	02	47 17	21 00 32 83	34 03
	ν Aquarii	07 36 32	16	11	11	10	02	36 04	04 21 69	35 04
	ε Cygni	12 06 15	10	37	13	14	02	05 65	08 51 34	31 00
	α Equulei	14 16 28	12	21	11	15	02	15 88	10 61 51	37 06
	γ Pavonis	21 44 11	31	57	27	20	05	44 39	18 30 16	24 08
	ζ Capricorni	24 25 71	17	04	12	23	02	25 37	21 11 04	33 02
	δ Aquarii	29 45 10	15	14	11	27	02	44 63	26 30 29	34 03

a = ·381 c = ·110

Chronometer correction at 20h 54m 3m 14s 311 ·009

W	ε Aquarii	21 35 53 26	16	13	13	49	02	53 57	21 32 38 47	3 15 10	02
	ι Pegasi	42 53 41	13	24	13	45	02	43 60	39 28 42	18	06
	δ Capricorni	44 59 31	17	08	13	43	02	59 60	41 44 50	10	02
	γ Gruis	51 21 62	21	09	16	38	03	22 01	48 06 84	17	05
	α Aquarii	22 04 06 36	15	18	13	28	02	06 42	22 00 51 35	07	05
	ι Pegasi	05 48 17	11	34	14	27	02	48 11	02 33 01	10	02
	α Tucani	1[illegible] 10 15	29	43	26	20	04	10 71	11 55 58	13	01
E	c^2 Aquarii	23 07 35 20	23	05	14	20	02	35 02	23 04 19 97	05	07
	γ Tucani	15 05 92	36	38	24	25	04	05 23	11 50 10	13	01
	τ Pegasi	19 09 63	15	33	13	28	02	09 02	15 53 84	18	06
	κ Piscium	25 16 71	19	19	13	33	02	16 23	21 61 13	10	02
	ι Phœnicis	33 10 32	28	14	17	39	03	10 15	29 55 03	12	00
	ι Piscium	38 17 02	18	21	13	42	02	16 42	35 01 26	16	04
	δ Sculptoris	47 11 45	25	00	14	49	02	11 05	43 55 96	09	03

a = ·388 c = ·126

Chronometer correction at 22h 41m 3m 15s 119 ·008

The following observations at Sydney, together with their reduction and clock corrections have been furnished by Mr. H. A. Lenehan, Acting Government Astronomer. The method of determining the level, azimuth and collimation errors there has already been given under 'Sydney Observatory.'

TRANSIT OBSERVATIONS.

Station: SYDNEY. Date, September 29th, 1903. Observer: H. A. LENEHAN.

Star.	Transit over mean of threads.	Level and collimation error.	Azimuth.	Rate.	Clock correction.
	h. m. s.	s.	s.	s.	s.
ε Delphini.	20 28 21 92	01	-2 [illegible]	[illegible]	
α Indi	20 30 36 64	02	1 [illegible]	[illegible]	15 30
ε Aquarii	20 42 13 98	01	[illegible]	[illegible]	23 12
α Aquarii	20 47 13 78	01	1 [illegible]	[illegible]	[illegible]
32 Vulpeculæ	20 50 11 80	01	3 [illegible]	[illegible]	[illegible]
1 Piscis Aust	20 55 10 67	02	4 [illegible]	[illegible]	40
				24 16	15 78

Chronometer correction at 20h 42m 15s 31

TRANSIT OBSERVATIONS.

Station: SYDNEY. Date, October 2nd, 19[illegible]. [illegible]

Star.	Transit over mean of threads.	Level and collimation error.	Azimuth.	Rate.	Clock correction.
	h. m. s.	s.	s.	s.	s.
ζ Capricorni.	20 45 18 88	01	-1 14		
α Pavonis	20 17 48 67	02	2 55		16 82
ε Delphini	20 28 18 21	01	-2 48		16 69
α Indi	20 30 33 09	02	1 19		16 96
α Delphini.	20 34 51 19	01	-2 74		16 54
ε Aquarii.	20 42 10 41	01	-1 39		16 97
α Aquarii	20 47 10 25	01	-1 44		16 89
θ Capricorni	21 00 15 09	01	-0 98		16 83
γ Pavonis	21 18 18 40	03	4 44		16 98
ζ Aquarii	21 26 11 96	01	-1 60		16 77
				Mean	16 85

Chronometer correction at 20h 44m 16s 85

TRANSIT OBSERVATIONS.

Station: SYDNEY. Date, October 3rd, 1903. Observer: W. E. RAYMOND.

Star.	Transit over mean of threads.	Level and in equality of pivots.	Azimuth.	Rate.	Seconds of over transit.	R. A.	Chronometer correction.
	h. m. s.	s.	s.			h. m. s.	s
α Aquarii	20 47 08 08	·04	1·46	Losing 1s 60 every 24 hours.	10 10	20 47 28 50	18 40
32 Vulpeculæ	20 50 06 57	·03	·3·43		9 97	20 50 28 53	18 56
ι Piscis Aust.	20 55 05 55	·00	0·09		5 58	20 55 24 09	18 51
θ Capricorni	21 00 13 61	·05	0·90		14 55	21 00 33 02	18 47
ι Capricorni	21 16 34 64	·05	1·04		35 63	21 16 54 11	18 48
γ Pavonis	21 18 16 87	·10	4·47		12 30	21 18 30 67	18 37
ζ Capricorni	21 29 52 00	·05	0·74		52 77	21 21 11 24	18 47
ψ Aquarii	21 26 10 41	·04	1·61		11 98	21 26 30 46	18 48
ε Aquarii	21 32 18 72	·04	1·51		20 19	21 32 38 64	18 45
ε Pegasi	21 39 07 66	·04	2·39		10 01	21 39 28 50	18 58
δ Capricorni	21 41 25 18	·05	1·04		26 17	21 41 44 66	18 49
γ Gruis	21 47 18 85	·06	0·31		48 48	21 48 07 04	18 56
						Mean	18 49

Chronometer correction at 21h 21m = 18s 49

TRANSIT OBSERVATIONS.

Station: SYDNEY. Date, October 6th, 1903. Observer: H. V. LENEHAN.

Star.	Transit over mean of threads.	Level and in equality of pivots.	Azimuth.	Rate.	Seconds of over transit.	R. A.	Chronometer correction.
	h. m. s.	s.	s.			h. m. s.	s
ζ Scorpii	15 59 27 08	·08	0·88	Losing 1s·18 per day.	27 88	15 59 49 61	21·73
δ Ophiuchi	16 08 53 81	·06	·1·75		55 50	16 09 17 34	21 84
α Scorpii	16 23 07 43	·08	·0·52		7 87	16 23 29 66	21 79
α Triang. Aust.	16 38 10 66	·17	5·46		5 03	16 38 26 88	21 85
ε Scorpii	16 43 33 50	·09	0·02		33 39	16 43 55 10	21 71
η Ophiuchi	17 04 28 11	·07	·1·08		29 12	17 04 51 00	21 88
						Mean	21·80

Chronometer correction at 16h 29m = 21s 80

α Aquarii	20 47 05 08	·07	·1·44	Losing 1s·32 per day.	6 45	20 47 28 45	·22 00
32 Vulpeculæ	20 50 02 98	·04	·3·40		6 34	20 50 28 47	22·13
ι Piscis Aust.	20 55 02 04	·09	·0·63		2 04	20 55 24 04	22 00
ψ Aquarii	21 26 06 81	·07	·1·66		8 34	21 26 30 43	22·09
γ Gruis	21 47 45 33	·09	0·30		44 94	21 48 07 00	22·06
α Aquarii	22 00 27 56	·06	·1·86		29 36	22 00 51 46	22 10
ε Pegasi	22 02 07 81	·04	·3·25		11 02	22 02 33 15	22 13
						Mean	22 07

Chronometer correction at 21h 24m = ·22s 07

TRANSIT OBSERVATIONS.

Station: SYDNEY. Date, October 7th, 1903. Observer, W. E. RAYMOND.

Star.	Transit over mean of threads.	Level and collimation equals.	Azimuth.	Rate.	Seconds of clock transit.	R. A.	Chronometer correction.
	h. m. s.	s.	s.			h. m. s.	s.
ι Piscis Aust.	20 55 00 49	06	00	Losing 1·43 per day.	0 52	20 55 24 03	24·51
θ Capricorni.	21 00 08 56	05	98		9 49	21 00 32 57	23 48
ι Capricorni.	21 16 29 61	05	1·04		30 10	21 16 54 06	23 46
ζ Capricorni	21 20 47 06	06	73		47 73	21 21 11 18	23 45
γ Aquarii	21 26 05 34	05	1·00		6 39	21 26 30 41	23 52
ξ Aquarii	21 32 13 64	05	1·50		15 00	21 32 38 59	23 50
ε Pegasi	21 39 02 05	04	2·38		4 39	21 39 28 54	23 55
δ Capricorni	21 41 20 12	05	1·04		21 11	21 41 44 62	23 51
α Aquarii.	22 00 26 08	05	1·86		27 89	22 00 51 45	23 56
ι Pegasi	22 02 06 28	03	3·26		9 51	22 02 33 14	23 63
γ Aquarii	22 25 00 48	05	1·35		10 78	22 25 34 29	23 51
η Aquarii	22 30 00 19	05	1·86		2 30	22 30 27 76	23 46
						Mean.	23 51

Chronometer correction at 21h 30m 24s·51

TRANSIT OBSERVATIONS.

Station: SYDNEY. Date, October 8th, 1903. Observer, W. E. RAYMOND.

Star.	Transit over mean of threads.	Level and collimation equals.	Azimuth.	Rate.	Seconds of clock transit.	R. A.	Chronometer correction.
	h. m. s.	s.	s.			h. m. s.	s.
γ Aquarii.	20 42 02 42	06	1·38	Losing 1·32 per day.	3 74	20 42 28 60	24·86
α Aquarii.	20 47 02 29	06	1·63		3 06	20 47 28 42	24 76
32 Vulpeculæ.	20 50 00 27	04	3·37		3 60	20 50 28 44	24 84
ι Piscis Aust.	20 54 59 23	08	0·09		59 24	20 55 24 01	24 77
θ Capricorni.	21 00 07 22	07	0·97		8 12	21 00 32 96	24 84
ι Capricorni	21 16 28 34	07	1·02		29 29	21 16 54 04	24 75
ζ Capricorni.	21 20 45 76	07	0·71		46 40	21 21 11 16	24 76
γ Aquarii	21 26 04 06	06	1·58		5 58	21 26 30 46	24 82
ξ Aquarii	21 32 12 36	06	1·48		13 78	21 32 38 58	24·80
ε Pegasi.	21 39 01 35	05	2·35		3 65	21 39 28 53	24 88
δ Capricorni	21 41 18 84	07	1·02		19 79	21 41 44 61	24 82
γ Gruis	21 47 42 57	08	0·30		42 19	21 48 06 97	24 78
α Aquarii.	22 00 24 75	06	1·84		26 53	22 00 51 44	24 91
σ Aquarii	22 25 08 11	06	1·33		1 38	22 25 34 28	24 90
						Mean.	24 82

Chronometer correction at 21h 23m 24s·82.

The following observations on November 5, January 22 and 23, were made for determining the differential personal equation between H. A. Lenehan, W. E. Raymond and Otto Klotz. The first two were the observers at Sydney during the longitude campaign, while the last was at Southport:

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station: SYDNEY. Date, November 5th, 1903. Observer: W. E. RAYMOND.

Star.	Corrected transit over mean of threads.	R. A.	Chronometer correction.
	h. m. s.	h. m. s.	s.
ε Aquarii	21 32 35·22	21 32 38·18	2·96
ε Pegasi	21 39 25·15	21 39 28·12	2·97
δ Capricorni	21 41 41·29	21 41 44·20	2·91
16 Pegasi	21 48 38·76	21 48 41·75	2·99
α Aquarii	22 00 48·17	22 00 51·07	2·90
ι Pegasi	22 02 29·74	22 02 32·70	2·96
e^2 Aquarii	23 04 16·87	23 04 19·74	2·87
ε Piscium	0 57 55·42	0 57 58·30	2·88
c^1 Piscium	1 08 40·64	1 08 43·61	2·97
		Mean	2·934

Chronometer correction at 23h 25m = 2s·934 = ·010

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station: SYDNEY. Date, November 5th, 1903. Observer: OTTO KLOTZ.

Star.	Corrected transit over mean of threads.	R. A.	Chronometer correction
	h. m. s.	h. m. s.	s.
7 Piscium	23 12 08·79	23 12 11·57	2·78
7 Pegasi	23 15 50·90	23 15 53·64	2·74
8 Piscium	23 21 58·11	23 21 60·97	2·86
ι Phœnicis	23 29 52·08	23 29 54·76	2·68
ι Piscium	23 34 58·30	23 34 61·11	2·81
27 Piscium	23 53 43·09	23 53 45·89	2·80
2 Ceti	23 58 46·86	23 58 49·65	2·79
α Andromedæ	0 03 23·49	0 03 26·32	2·83
7 Pegasi	0 08 15·24	0 08 18·16	2·92
ι Ceti	0 14 29·89	0 14 32·60	2·71
44 Piscium	0 20 26·51	0 20 29·41	2·90
12 Ceti	0 25 05·95	0 25 08·87	2·92
ε Andromedæ	0 33 27·01	0 33 29·86	2·85
		Mean	2·815

Chronometer correction at 23h 25m = 2s·815 = ·015

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station: SYDNEY. Date, November 5th, 1903. Observer: H. A. LENEHAN

Star	Corrected transit over mean of threads.	R.A.	Chronometer correction.
	h. m. s.	h. m. s.	s.
σ Aquarii	22 25 31·04	22 25 33·95	+2·91
η Aquarii	22 30 22·55	22 30 25·45	+2·90
ζ Pegasi	22 36 37·66	22 36 40·62	+2·96
η Pegasi	22 38 27·70	22 38 30·59	+2·89
μ Pegasi	22 45 19·76	22 45 22·58	+2·82
λ Aquarii	22 47 33·61	22 47 36·45	+2·84
α Sculptoris	0 53 56·47	0 53 59·28	+2·81
β Phœnicis	1 01 45·90	1 01 48·58	+2·68
η Cetti	1 19 11·35	1 19 14·11	+2·76
		Mean	+2·841

Chronometer correction at 23h 25m +2·841 ±·019

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station: SYDNEY. Date, January 22nd, 1904. Observer: W. E. RAYMOND.

Star.	Corrected transit over mean of threads.	R.A.	Chronometer correction.
	h. m. s.	h. m. s.	s.
δ Eridani	3 38 08·37	3 38 39·67	31·30
α Tauri	4 29 54·66	4 30 25·89	31·23
53 Eridani	4 33 16·85	4 33 48·00	31·15
π¹ Orionis	4 44 07·61	4 44 38·87	31·26
α Leporis	5 27 59·87	5 28 31·04	31·17
β Canis Majorum	6 17 58·51	6 18 29·82	31·31
ε Geminoris	6 37 32·11	6 38 03·24	31·13
		Mean	31·221

Chronometer correction at 5h 32m +31s·221 ±·018

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station: SYDNEY. Date, January 22nd, 1904. Observer: H. A. LENEHAN.

Star.	Corrected transit over mean of threads.	R.A.	Chronometer correction.
	h. m. s.	h. m. s.	s.
τ Tauri	4 35 59·13	4 36 30·24	+31·11
β Orionis	5 09 25·49	5 09 56·68	31·19
δ Orionis	5 26 36·23	5 27 07·42	31·19
α Columbæ	5 35 40·58	5 36 11·81	31·23
ζ Canis Majoris	6 16 08·08	6 16 39·23	31·15
γ Geminorum	6 31 40·34	6 32 11·56	31·22
		Mean	31·182

Chronometer correction at 5h 32m +31s·182 ±·012

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station: SYDNEY. Date, January 22nd, 1904. Observer: OTTO KLOTZ

Star.	Corrected transit over mean of threads.	R. A.	Chronometer correction.
	h. m. s.	h. m. s.	s.
μ Eridani	4 40 11·09	4 40 43·23	+31·24
ε Leporis	5 00 53·88	5 01 25·01	31·13
γ Orionis	5 19 28·90	5 19 60·22	31·32
ε Orionis	5 30 50·54	5 31 21·84	31·30
η Geminorum	6 08 35·40	6 09 06·56	31·16
ν Geminorum	6 22 46·16	6 23 17·37	31·21
ξ Geminorum	6 39 24·43	6 39 55·65	31·22
		Mean	31·226

Chronometer correction at $5^h\ 32^m$ = 31s·226 ± ·017

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station: SYDNEY. Date, January 23rd, 1904. Observer: W. E. RAYMOND.

Star.	Corrected transit over mean of threads.	R. A.	Chronometer correction.
	h. m. s.	h. m. s.	s.
γ^1 Eridani	3 53 01·26	3 53 33·80	+32·54
τ Tauri	4 35 57·74	4 36 30·23	32·49
ε Leporis	5 00 52·32	5 01 25·00	32·68
δ Orionis	5 26 34·66	5 27 07·41	32·75
κ Orionis	5 42 40·91	5 43 13·56	32·65
β Canis Majoris	6 17 57·12	6 18 29·81	32·69
		Mean	32·633

Chronometer correction at $5^h\ 20^m$ = 32s·633 ± ·027

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station: SYDNEY. Date, January 23rd, 1904. Observer: H. A. LENEHAN.

Star.	Corrected transit over mean of threads.	R. A.	Chronometer correction.
	h. m. s.	h. m. s.	s.
o^2 Eridani	4 06 39·21	4 07 11·64	32·43
μ Eridani	4 40 10·70	4 40 43·22	32·52
β Orionis	5 09 24·04	5 09 56·67	32·63
ε Orionis	5 30 49·19	5 31 21·83	32·64
η Geminorum	6 08 33·94	6 09 06·55	32·61
ν Geminorum	6 22 44·72	6 23 17·37	32·65
		Mean	32·580

Chronometer correction at $5^h\ 20^m$ = + 32s·580 ± ·024

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station: SYDNEY. Date, January 23rd, 1904. Observer: OTTO KLOTZ.

Star.	Corrected transit over mean of threads.	R. A.	Chronometer correction.
	h. m. s.	h. m. s.	s.
53 Eridani	4 33 15·49	4 33 47·99	32·50
π^1 Orionis	4 44 06·28	4 44 38·86	32·58
γ Orionis	5 19 27·60	5 19 60·22	32·62
α Columbæ	5 35 39·12	5 36 11·80	32·68
ζ Canis Majoris	6 16 06·60	6 16 39·22	32·62
γ Geminorum	6 31 38·87	6 32 11·56	32·69
		Mean	32·615

Chronometer correction at $5^h\ 20^m$ = 32·615 + ·019

PERSONAL EQUATION.

Date.	Clock Correction. Klotz.		Lenehan.		Raymond.		K-L	K R
	s.	s.	s.	s.	s.	s.	s.	s.
Nov. 5, 1903	+ 2·815	·015	+ 2·841	·019	+ 2·934	+ ·010	·026	·119
Jan. 22, 1904	+ 31·226	+ ·017	+ 31·182	+ ·012	+ 31·221	·018	+ ·044	·005
" 23, 1904	+ 32·615	·019	+ 32·580	·024	+ 32·633	+ ·027	+ ·035	·018
Weighted							+ ·018	+ ·015 ·067 + ·027

That is, Klotz anticipates Lenehan, and Raymond anticipates Klotz.

TRANSIT OBSERVATIONS.

Station: BRISBANE. Date, September 29th, 1903. Observer: THOS. D. FRASER.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	δ Pavonis	19 58 33 55	·02	04	1·16	·01	05	32 39	19 59 17 93	·45·54	17
	α² Capricorni	20 11 58 09	·02	01	·18	·01	02	37 59	20 12 43 52	93	22
	ϑ Capricorni	14 51 55	02	01	·48	·01	02	51 05	15 36 88	83	12
	γ Cygni	18 02 46	01	03	·60	01	02	01 87	18 47 56	69	02
	μ Capricorni	22 37 70	02	00	·49	00	02	37 21	23 22 95	74	03
	α Delphini	34 25 75	·01	02	·48	00	02	25 24	35 10 93	·69	02
	ε Aquarii	41 43 43	02	01	·47	00	·02	42 95	42 28 73	·78	07
W	θ Capricorni	59 47 05	02	00	·49	00	02	47 50	21 00 33 08	58	13
	ζ Cygni	21 08 05 56	·01	02	·53	00	02	06 04	08 51 65	61	10
	γ Pavonis	17 43 89	05	04	1·13	00	05	44 96	18 30 81	85	14
	ζ Capricorni	20 25·05	02	00	·50	01	02	25 52	21 11 28	76	05
	ϑ Aquarii	25 44 47	·02	01	·47	·01	02	44 90	26 30 51	·61	10
	ξ Aquarii	31 52 57	02	·61	·47	01	02	53 00	32 38 69	69	·02
	δ Capricorni	40 58 62	02	00	·48	01	02	59 07	41 44 72	·65	·06

a ·024 ·462

Chronometer correction at $20^h\ 50^m$ 45·715 ·022

W	σ Aquarii	22 24 48·31	·10	02	·47	·01	02	48·63	22 25 34 35	·45·72	02
	η Aquarii	29 39 76	·09	04	·46	·00	02	40 07	30 25 82	75	01
	ε Poisson	34 34 97	11	00	·52	00	·02	35 36	35 21·07	71	03
	η Pegasi	37 44 98	08	08	·53	00	02	45 33	38 31 03	70	04
	ε Gruis	41 59 49	·14	·06	·75	·00	03	60 13	42 45 83	·70	04
	λ Aquarii	46 50 69	09	03	·46	00	·02	51 01	47 36 79	·78	·04
	δ Aquarii	48 47 49	10	02	·48	00	02	47 83	49 33 70	87	·13
E	α Pegasi	59 14 26	·01	06	47	00	02	13·70	59 59·38	·68	·06
	α² Aquarii	23 03 34 78	02	01	·50	00	02	34 23	23 04 20 07	84	10
	γ Toucani	11 05 52	02	·09	·89	00	·04	04 66	11 50 33	67	07
	τ Pegasi	15 08·81	01	07	·50	00	02	08 21	15 53 92	71	03
	κ Piscium	21 16 05	01	04	·48	·00	02	15·52	22 01 20	·68	·06
	ι Piscium	34 16 07	01	05	·46	·01	·02	15·54	35 01 30	·76	02

a ·086 ·461

Chronometer correction at $22^h\ 57^m$ 45·737 ·014

TRANSIT OBSERVATIONS.

Station: BRISBANE. Date, October 2nd, 1903. Observer: THOS. D. FRASER.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit	R. A.	Chronometer correction.	c.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	α^2 Capricorni.	20 11 56·84	·01	·03	·42	·02	02	56·40	20 12 43·46	47·06	·15
	β Capricorni.	14 50·06	·01	·03	·42	·01	02	49·62	15 36·84	·22	·01
	γ Cygni	18 00·93	·02	·16	·53	·01	02	00·23	18 47·49	·23	·05
	β Pavonis .	35 31·86	·07	·22	1·01	·01	05	35·70	23 22·90	·20	·01
	ϵ Aquarii . . .	41 41·96	·04	·04	·41	·01	02	31·08	36 18·40	·32	·11
	μ Aquarii . .	46 41·76	·04	·04	·41	·00	02	41·52	42 28·68	·16	·05
W	ζ Cygni .	21 08 04·00	·02	·13	·47	·00	02	41·33	47 28·51	·18	·03
	γ Pavonis	17 42·43	·00	·21	·99	·01	02	04·30	21 08 51·59	·29	·08
	ζ Capricorni. . . .	20 23·63	·03	·01	·44	·01	05	43·53	18 30·70	·17	·04
	β Aquarii	25 43·01	·03	·05	·41	·01	02	24·02	21 11·24	·22	·01
	ϵ Aquarii .	31 51·01	·03	·04	·41	·01	02	43·33	26 30·48	·15	·06
	λ Capricorni . .	53 58·90	·03	·03	·43	·01	02	51·34	32 38·66	·32	·11
	δ Capricorni . . .	40 57·13	·03	·03	·42	·01	02	59·26	34 46·47	·21	·00
							02	57·48	41 44·69	·21	·00

a ·138 c ·404

Chronometer correction at $20^h\ 56^m$ 47·215 ·014

W	γ Aquarii.	22 15 54·75	·06	·04	·50	·02	02	55·11	22 16 42·21	47·10	·10
	η Aquarii .	29 38·19	·05	·04	·50	·01	02	38·57	30 25·80	·23	·03
	ϵ Poissons. . . .	34 33·34	·06	·00	·57	·01	02	33·82	35 21·05	·23	·03
	η Pegasi.	37 43·35	·04	·08	·58	·01	02	43·78	38 31·00	·22	·02
	ϵ Gruis	41 58·04	·08	·06	·81	·01	03	58·79	42 45·79	·00	·20
	λ Aquarii.	46 49·23	·05	·02	·51	·01	02	49·64	47 36·77	·13	·07
	δ Aquarii	48 46·13	·05	·02	·52	·01	02	46·55	49 33·68	·13	·07
E	σ^2 Aquarii .	23 03 33·41	·02	·01	·54	·00	02	32·82	23 04 20·06	·24	·04
	γ Toucani	11 03·92	·03	·08	·97	·00	03	02·97	11 50·30	·33	·13
	τ Pegasi . .	15 07·43	·01	·07	·55	·00	02	06·78	15 53·91	·13	·07
	κ Piscium .	21 14·47	·01	·04	·54	·01	02	13·91	22 01·19	·28	·08
	ι Piscium	34 14·61	·01	·05	·51	·01	02	14·03	35 01·29	·26	·06
	δ Sculptoris . . .	43 09·27	·02	·00	·57	·01	02	08·67	43 56·00	·33	·13
	^{27} Piscium . . .	52 59·36	·01	·03	·50	·02	02	58·82	53 46·02	·20	·00

a ·083 c ·502

Chronometer correction at $23^h\ 04^m$ 47·200 ·018

TRANSIT OBSERVATIONS.

Station: BRISBANE. Date, October 3rd, 1903. Observer: THOS. D. FRASER.

Clamp.	Star	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Zenith-tube correct.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	α^2 Capricorni	20 11 56·63	·00	·02	·51	·01	02 55 47		20 12 43·45	·47·98	·03
	β Capricorni	14 49 33	·00	·02	·51	·01	02 48 77		15 36 82	48·05	·10
	γ Cygni	17 60 16	·00	·09	·64	·01	02 50 40		18 47 46	·06	·11
	ρ Capricorni	22 35 49	·00	·01	·52	·01	02 34·93		23 22 88	47·95	·00
	β Pavonis.	35 31 57	·00	·12	1·23	·00	05 30 41		36 18 36	·95	·00
	ζ Capricorni	39 37 24	·00	·00	·55	·00	02 26 67		40 24 55	·88	·07
	ϵ Aquarii.	41 41 31	·00	·02	·50	·00	02 40 77		42 28 69	·92	·03
W	ζ Cygni	21 08 03 24	·02	·07	·56	·00	02 03 69		21 08 51 58	·89	·06
	γ Pavonis.	17 41 46	·06	·11	1·20	·00	05 42 66		18 30 67	48·01	·06
	ζ Capricorni.	20 22 86	·04	·01	·54	·00	02 23 33		21 11 23	47·90	·05
	β Aquarii	25 42 14	·03	·02	·50	·00	02 42 57		26 30 46	·89	·06
	ϵ Aquarii	31 50 37	·03	·02	·50	·01	02 50·81		32 38 64	·83	·12
	γ Capricorni.	33 57·98	·03	·01	·52	·01	02 58 45		34 46 48	48·02	·08
	δ Capricorni.	40 56 22	·03	·02	·51	·01	02 56 67		41 44 67	48·00	·05

a = ·079 c = ·491

Chronometer correction at $20^h\ 56^m$ = 47s·954 ±·014

W	σ Aquarii.	22 24 46·04	·05	·00	·45	·01	02 46 41		22 25 34·32	47·91	·06
	η Aquarii.	29 37 50	·05	·00	·44	·01	02 37 86		30 25 79	·93	·04
	ϵ Poisson..	34 32 59	·06	·00	·50	·01	02 33 00		35 21 04	48·04	·07
	η Pegasi	37 12 65	·04	·01	·51	·01	02 43 10		38 50 93	·89	·08
	ϵ Gruis..	41 57 19	·08	·01	·72	·01	03 57·78		42 45 77	·99	·02
	λ Aquarii.	46 48 39	·05	·00	·45	·01	02 48 76		47 36 76	48·00	·03
	δ Aquarii.	48 45 28	·06	·00	·46	·01	02 45 65		49 33 67	·02	·05
E	ϵ^1 Aquarii.	23 03 32 53	·00	·00	·48	·00	02 32 03		23 04 20·05	·02	·05
	γ Toucani	11 03 26	·00	·01	·86	·00	03 02 36		11 50 29	47·93	·04
	τ Pegasi	15 06 32	·00	·01	·48	·00	02 05 83		15 53 91	48·08	·17
	κ Piscium	21 13 70	·00	·00	·44	·00	02 13 24		22 01 18	47·94	·03
	ϵ Piscium	34 13 84	·00	·00	·45	·01	02 13 38		35 01·29	·91	·06
	δ Sculptoris.	42 08 55	·00	·00	·51	·01	02 08 03		43 56 00	·97	·00
	27 Piscium	52 58 49	·00	·00	·44	·01	02 58 04		53 46 02	·98	·01

a = ·006 c = ·444

Chronometer correction at $23^h\ 08^m$ = 47s·971 ±·012

TRANSIT OBSERVATIONS.

Station: BRISBANE. Date, October 6th, 1903. Observer: THOS. D. FRASER

Clamp.	Star.	Transit over mean of threads.	Level and in equality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of equat. interval.	R. A.	Chronometer corr. to G.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	μ Capricorni	20 22 32·64	·01	·02	·46	·01	·02	32·12	20 23 22·83	-50·71	·07
	β Pavonis	35 28 42	·01	·33	1·10	·01	·05	27·58	36 18 23	·65	·01
	ψ Capricorni	39 34 43	·01	·01	·49	·01	·02	33·89	40 24 50	·61	·03
	ε Aquarii	41 38 55	·01	·06	·44	·01	·02	38·01	42 28 62	·61	·03
	ω Aquarii	46 38 45	·01	·06	·44	·00	·02	37·92	47 28 45	·53	·11
	32 Vulpeculæ	49 38 50	·00	·19	·49	·00	·02	37·80	50 28 47	·67	·03
	θ Capricorni	59 42·95	·01	·04	·46	·00	·02	42·12	60 32 99	·57	·07
W	γ Pavonis	21 17 38·86	·17	·30	-1·07	·00	·05	40·01	21 18 30·56	·55	·09
	ζ Capricorni	20 20 11	·10	·02	·48	·00	·02	20·45	21 11 19	·74	·10
	ε Aquarii	25 39·50	·08	·07	·44	·00	·02	39·77	26 30 43	·66	·02
	ι Pegasi	38 37 71	·07	·12	·44	·00	·02	47·96	32 38 61	·65	·01
	δ Capricorni	40 53·67	·09	·04	·46	·00	·02	37·94	39 28 56	·62	·02
	ι Pegasi	22 01 42 26	·06	·17	·48	-·01	·02	42·50	22 02 33 15	·65	·01

$a = -^s·204$ $c = -^s·438$

Chronometer correction at $21^h\ 12^m = -50^s·636 - ^s·012$

W	ε Gruis	22 41 54·57	·26	-·02	-·75	·01	·03	55·04	22 42 45·74	-50·70	·06
	μ Pegasi	44 32·05	·12	·03	-·50	·01	·02	32·37	45 22 91	·54	-·10
	λ Aquarii	46 45 86	·17	·01	-·47	·01	·02	46·12	47 36·74	·62	·02
	δ Aquarii	48 42·77	·18	·01	-·48	·01	·02	43·03	49 33·65	·62	-·02
	c^2 Aquarii	23 03 29·13	-·19	·00	-·50	·00	·02	30·40	52 21·08	·68	·04
E	γ Toucani	11 00·80	·22	-·03	·89	·00	·03	59·69	11 50·26	·57	·07
	κ Piscium	21 11·19	·12	·02	·46	·00	·02	10·57	22 01·18	·61	-·03
	ι Piscium	34 11·27	·11	·02	-·47	·00	·02	10·65	35 01·29	·64	·00
	δ Sculptoris	43 06·00	-·15	·00	-·53	·00	·02	05·30	43 56·00	·70	·06
	φ Pegasi	46 46·91	·10	-·02	-·49	·00	·02	46·28	47 36·98	·70	·06
	27 Piscium	52 55·99	·13	-·01	-·46	-·01	-·02	55·38	53 46·03	·65	·01
	2 Ceti	57 59·80	-·14	-·01	-·48	-·01	·02	59·16	58 49·80	·64	·00

$a = -^s·034$ $c = -^s·462$

Chronometer correction at $23^h\ 19^m = -50^s·638 - ^s·010$

TRANSIT OBSERVATIONS.

Station: BRISBANE. Date, October 7th, 1903. Observer: THOS. D. FRASER.

Clamp	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	v.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	ρ Capricorni	20 22 31 81	·09	·62	·53	·01	·02	31 32	20 23 22 81	·51 49	·01
	ϑ Pavonis	35 27 67	·17	·23	1·26	·01	·05	26 75	36 18 19	·44	·04
	ψ Capricorni	39 33 40	·10	·01	·56	·00	·02	32 91	40 24 49	·58	·10
	ε Cygni	41 29 21	·05	·16	·60	·00	·02	28 48	42 20 00	·52	·04
	α Aquarii	46 37 51	·08	·05	·51	·00	·02	37 01	47 28 44	·43	·05
	32 Vulpeculæ	49 37 70	·06	·14	·57	·00	·02	37 03	50 28 46	·43	·05
	θ Capricorni	59 41 88	·09	·03	·53	·00	·02	41 39	21 00 32 93	·54	·06
W	γ Pavonis	21 17 37 49	·11	·22	·1 22	·00	·05	38 99	18 30 52	·53	·05
	ζ Capricorni	20 19 13	·07	·01	·55	·00	·02	19 72	21 11 18	·46	·02
	ϑ Aquarii	25 38 51	·06	·05	·51	·00	·02	39 01	26 30 41	·49	·08
	ξ Aquarii	31 46 61	·06	·05	·51	·00	·02	47 11	32 38 60	·49	·01
	γ Capricorni	35 54 39	·06	·03	·53	·00	·02	54 93	34 46 41	·48	·00
	δ Capricorni	40 52 62	·06	·03	·52	·01	·02	53 16	41 14 63	·47	·01
	16 Pegasi	47 50 28	·04	·13	·56	·01	·02	50 74	48 42 20	·46	·02

a ·153 c ·503

Chronometer correction at 21h 05m 51s·479 ·010

W	δ Aquarii	22 48 41 60	·09	·01	·43	·01	·02	42 08	22 49 33 65	·51 5[illegible]	·05
	α Pegasi	59 07·37	·06	·04	·43	·01	·02	07 79	59 59 34	·55	·03
	e^2 Aquarii	23 03 27 93	·[illegible]	·01	·45	·00	·02	28 44	23 04 20 04	·60	·08
	γ Toucani	10 58·01	·13	·06	·80	·00	·03	58 97	11 50·25	·28	·24
	τ Pegasi	15 01 92	·06	·05	·45	·00	·02	02 36	15 53 89	·53	·01
	κ Piscium	21 09 16	·07	·03	·41	·00	·02	09 59	21 61 17	·58	·06
	ι Piscium	34 09 29	·07	·04	·41	·00	·02	09 71	35 01 29	·58	·06
E	δ Sculptoris	43 04 80	·13	·00	·47	·00	·02	04 44	43 56 00	·56	·04
	φ Pegasi	46 45 88	·09	·05	·44	·00	·02	45 46	47 36 98	·52	·00
	27 Piscium	52 54 81	·11	·03	·41	·00	·02	54 46	53 46 03	·57	·05
	30 Poisson	56 11 56	·11	·02	·42	·00	·02	11 21	57 02 72	·51	·01
	ι Ceti	57 58 63	·12	·01	·43	·00	·02	58·29	58 49 80	·51	·01
	α Andromedæ	24 02 35·37	·08	·06	·47	·01	·02	34 91	24 03 26 45	·54	·02
	ζ Toucani	14 14 84	·23	·09	1·00	·01	·04	14 13	15 05 55	·42	·10

a ·063 c ·413

Chronometer correction at 23h 31m 51s·522 ·016

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station: Southport. Date, October 23rd, 1903. Observer: Otto Klotz

Clamp.	Star.	Transit over mean of threads.	Level and collimation correction.	Azimuth.	Collimation.	Rate.	Declination.	Seconds of declination.	R. A.	Chronometer correction.	r.
		h. m. s.	s.	s.	s.	s.	°	′	h. m. s.	m. s.	s.
E	α Toucani	22 16 35 30	·15	·54	·30	·45	62	04 36·27	22 11 55·37	4 40·90	·05
	γ Aquarii	21 22 62	·08	·21	·14	·59	02	22·92	16 41·99	·93	·08
	σ Aquarii	30 14 71	·08	·14	·15	·52	02	15·00	25 34·12	·88	·03
	η Aquarii	35 06 23	·08	·22	·14	·48	02	06·41	30 25·59	·82	·03
	ζ Pegasi	41 21 56	·07	·30	·15	·44	02	21·60	36 40·78	·82	·03
	η Pegasi	43 11 73	·05	·47	·17	·42	02	11·54	38 30·78	·76	·09
	μ Pegasi	50 03 71	·00	·42	·16	·37	02	03·54	45 22·78	·76	·09
W	δ Sculptoris	23 48 36 97	·10	·00	·16	·07	02	36·88	23 43 55·91	·97	·12
	φ Pegasi	52 18 32	·10	·37	·15	·10	02	17·88	47 36·92	·96	·11
	ω Piscium	59 04 67	·10	·28	·15	·15	02	04·27	54 23·43	·84	·04
	2 Ceti	24 03 30 86	·12	·09	·15	·18	02	30·60	58 49·75	·85	·00
	α Andromedæ	08 07·85	·07	·16	·16	·22	02	07·24	24 03 26·41	·83	·02
	γ Pegasi	12 59·56	·08	·34	·15	·25	02	59·02	08 18·22	·80	·05
	ζ Toucani	19 45·62	·21	·71	·35	·30	05	46·12	15 05·37	·75	·10

a = ·484 c = ·44

Chronometer correction at 23h 39m 4m 40s·848 ·015

Observer: Thos. D. Fraser.

Clamp.	Star.	Transit over mean of threads.	Level and collimation correction.	Azimuth.	Collimation.	Rate.	Declination.	Seconds of declination.	R. A.	Chronometer correction.	r.
						r ·45					
E	α Pegasi	23 04 39 98	·11	·31	·14	·26	02	39·88	22 59 59·21	4 40·67	·09
	σ² Aquarii	09 00·42	·16	·05	·14	·23	·02	00·60	23 04 19·90	·70	·06
	γ Toucani	16 30·19	·25	·44	·26	·17	·04	30·75	11 49·95	·80	·04
	τ Pegasi	20 34·82	·10	·38	·15	·14	02	34·51	15 53·78	·73	·03
	κ Piscium	26 41·57	·13	·21	·13	·10	02	41·84	21 61·08	·76	·00
	ι Phœnicis	34 35·63	·20	·16	·18	·04	03	35·82	29 54·95	·87	·11
	ι Piscium	39 42·17	·13	·24	·13	·00	02	41·91	35 01·22	·69	·07
W	ε Hydri	0 25 24 31	·39	1·60	·63	·34	09	25·72	0 20 45·01	·71	·05
	12 Ceti	29 50·41	·12	·18	·13	·38	02	49·84	25 08·92	·92	·16
	ε Andromedæ	38 11·49	·08	·42	·15	·44	02	10·68	33 29·91	·77	·01
	δ Piscium	43 28·17	·14	·08	·14	·48	02	27·59	38 46·77	·72	·06
	20 Ceti	48 24·28	·11	·26	·14	·52	02	23·51	43 12·74	·77	·01
	α Andromedæ	52 48·22	·12	·20	·13	·55	02	47·46	48 06·70	·76	·00
		56 08·41	·06	·51	·17	·58	02	07·41	51 26·68	·73	·03

a = ·443 c = ·134

Chronometer correction at 23h 39m 4m 46s·765 ·014

PERSONAL EQUATION

TRANSIT OBSERVATIONS

Station, [illegible] Date, October 29th, 1905 Observer, Otto Klotz

Group	Star	Transit average of threads	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	R. A.	[illegible]
		h. m. s.	s.	s.	s.	s.	s.	s.		h. m. s.	m. s.
E	α Pegasi	22 44 16 22	00	02	13	02	02	15 79		22 45 17 67	1 06 88 04
	λ Aquarii	46 21 26	0	01	10	0	02	29 53		47 36 53	07 00 08
	5 Aquarii	48 25 88	0	01	11	0	02	26 18		49 33 11	06 96 04
	1 Pegasi	58 2 61	0	02	11	01	02	22		59 59 14	93 00
	ε Aquarii	23 03 13 31	0	03	15	01	0	12 89		23 04 19 83	91 02
	7 Tucani	10 13 69	00	02	76	01	03	12 93		11 19 81	88 04
	2 Pegasi	11 17 28	0	02	13	01	0	16 87		11 53 71	84 03
W	12 Ceti	24 24 01 75	03	01	51	02	02	01 92		24 25 08 91	90 07
	1 Ceti	37 39 31	03	00	51	0	02	39 72		38 46 76	07 04 72
	5 Piscium	42 35 42	03	01	10	02	02	35 80		43 12 73	06 93 01
	20 Ceti	46 9 39	03	01	51	02	02	29 76		48 06 69	93 01
	1 Piscium	56 51 05	03	01	10	03	02	0 44		57 7 32	88 04
	3 Phœnicis	25 00 41 31	06	01	60	03	03	11 81		25 01 18 61	80 12
	9 Ceti	18 06 85	01	01	16	03	02	07 23		19 14 11	88 04

α = ·025 α = 394

Chronometer correction at 23h 35m 1m 06s·918 ± ·013

Observer, Thos. D. Fraser

Group	Star	Transit average of threads	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	R. A.	[illegible]
						r	02				
E	α Aquarii	21 59 44 44	03	08	51	03	02	44 00		22 00 51 17	1 07 17 04
	ε Pegasi	22 01 26 06	02	16	55	03	02	25 64		02 32 81	17 04
	α Tucani	10 19 27	06	[illegible]	1 03	03	04	18 02		14 55 17	15 02
	5 Aquarii	15 35 20	03	[illegible]	50	03	02	34 76		16 11 92	16 03
	3 Aquarii	24 27 38	03	05	51	02	02	26 91		25 34 05	14 01
	9 Aquarii	29 18 86	03	08	50	02	02	18 43		30 25 54	11 02
	1 Pegasi	35 34 04	03	12	51	02	02	33 64		36 10 71	07 06
W	ε Piscium	23 33 53 66	03	04	51	00	02	54 14		23 34 61 17	63 10
	5 Sculptoris	42 18 09	04	00	57	00	02	48 68		43 55 86	18 05
	φ Pegasi	46 29 28	02	05	53	00	02	29 76		47 36 89	13 00
	27 Piscium	52 38 11	03	03	50	01	02	38 90		53 15 95	05 08
	2 Ceti.	57 12 11	03	01	53	01	02	12 65		58 49 71	06 07
	α Andromedæ	24 02 18 57	02	07	57	01	02	19 08		24 03 26 48	30 17
	3 Hydri.	19 34 98	10	26	2 37	01	02	37 63		20 14 77	14 01

α_1 = ·188 α = 072 = ·500

Chronometer correction at 23h 35m 1m 07s·134 ± ·014

Hence the weighted personal equation of the two values, Fraser anticipates Klotz ·153 ± ·014

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date, December 5th, 1903. Observer, F. W. O. WEIRY.

Star	Transit Corrected for Errors	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	h. m. s.	s.	s.	s.	s.	s.	s.	h. m. s.	s.	s.
E 3 Phœnicis.	1 02 06 26	05	30	70	28	03	06 06	1 01 48 14	17 92	01
4 Piscium.	09 02 07	03	30	48	23	02	01 38	08 43 46	17 92	01
21	19 22 40	03	23	48	16	02	31 59	19 13 05	17 94	03
5 Phœnicis.	24 50 57	05	23	66	12	03	30 18	24 12 18	18 00	09
32	26 40 20	03	47	49	10	02	30 20	26 21 11	17 85	06
7 Eridani.	30 26 98	06	50	80	04	03	26 03	31 08 80	17 74	17
Piscium	30 45 53	03	30	48	03	02	44 04	36 26 75	17 89	02
W 542.	39 54 84	08	14	49	01	02	55 10	39 37 01	18 09	18
544.	47 01 76	08	21	48	05	02	01 88	46 43 87	18 01	10
37.	2 23 22 30	02	40	48	32	02	22 02	2 22 61 09	17 93	02
Eridani.	27 50 85	02	16	49	35	02	50 79	27 32 95	17 84	07
Cet.	31 09 18	02	26	48	38	02	08 98	30 50 99	17 99	08
5	33 41 13	02	54	51	40	02	40 06	33 22 89	17 77	14
38.	34 52 55	02	32	48	41	02	52 26	34 34 49	17 77	14

$a = \cdot 657$ $e = \cdot 475$

Chronometer correction at $1^h\ 40^m$ $17^s \cdot 905 \pm \cdot 023$

W 547.	2 39 52 15	02	13	46	23	02	52 67	2 39 33 97	18 70	12
3 Fornacis	45 23 12	02	04	53	19	02	23 84	45 05 22	62	04
46.	52 03 36	02	17	45	14	02	03 74	51 45 07	67	09
Arietis.	54 02 82	02	40	47	12	02	02 97	53 44 40	55	01
47.	57 34 87	02	25	44	10	02	35 10	57 16 54	56	9
α Horologii.	3 01 39 45	03	51	80	07	04	40 85	3 01 22 40	45	
E 549.	08 19 50	02	00	51	02	02	19 10	07 60 44	66	08
53.	19 59 23	02	31	45	06	02	58 41	19 39 83	58	00
55.	25 54 88	01	33	45	11	02	53 98	25 35 39	59	01
B.A.C. 1106	30 03 49	03	29	70	15	03	02 93	29 44 24	69	11
10 Tucanæ	32 18 75	02	24	44	17	02	17 90	31 59 45	45	13
550.	38 59 22	02	16	45	21	02	58 40	38 39 98	42	16

$a = \cdot 492$ $e = \cdot 443$

Chronometer correction at $3^h\ 10^m$ $18^s \cdot 580 \pm \cdot 021$

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date, December 9th, 1903 Observer: F. W. O. WEBBY.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of clock transit.	R. A.	Chronometer correction.	[illegible]
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	47.	2 58 02 16	02	24	53	14	02	01 49	2 57 16 54	44 95	07
	α Horologii	3 02 07 68	03	-47	1 06	13	04	07 15	3 01 22 32	83	05
	359.	06 55 19	01	36	56	10	02	51 34	06 09 41	93	05
	549.	08 45 76	-02	00	61	-09	02	15 20	08 00 43	77	11
	ν Arietis	10 09 92	01	37	56	09	02	09 05	09 24 10	95	07
	ε Eridani	16 52 12	02	-15	73	06	03	51 55	16 06 68	87	01
	51	20 25 52	02	28	53	04	02	24 71	19 39 81	90	02
	54.	22 44 72	02	29	53	03	02	13 89	21 59 01	88	00
W	55	25 29 16	08	31	-54	02	02	29 31	25 35 39	92	04
	B.A.C. 1106.	30 28 22	16	-26	83	00	03	29 12	29 14 21	91	03
	10 Tauri au	32 44 09	09	22	53	01	02	14 28	31 59 45	83	05
	61.	42 32 75	07	39	57	06	02	32 78	41 47 85	93	05
	g Eridani	46 37 22	13	-07	67	07	03	37 71	45 52 91	80	08
	552.	54 18 70	11	12	44	10	02	18 79	53 34 02	77	11

a = -·453 c = -·527

Chronometer correction at 3h 30m 44s·876 ·012

TRANSIT OBSERVATIONS.

Station Norfolk Island. Date, December 10th, 1903. Observer F. W. O. Wells.

Object.	Star.	Transit over mean of threads	Error of clock by Sidereal Time	Azimuth	Correction	Rate	Variation of rate	Corrected transit	R. A.	Chronometer correction	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	α¹ Piscium.	1 00 35 22	01	32	49	12	02 34 52	1 08 43 12	51 10	01	
	7. Phœnicis	25 03 61	01	19	57	05	03 03 16	24 12 10	06	03	
	22	2, 13 40	01	33	50	05	02 12 56	26 21 40	16	07	
	τ Piscium	37 18 62	01	32	48	01	02 17 82	36 26 74	08	01	
	542.	40 28 68	01	12	50	00	02 28 05	39 36 97	08	01	
	25.	41 12 03	01	33	49	00	02 11 20	40 26 07	13	04	
	543.	42 01 04	01	01	54	01	02 00 44	41 00 37	07	02	
W	η Baleine.	45 43 52	06	17	49	02	02 43 74	44 52 72	02	07	
	544.	47 31 02	06	17	49	02	02 31 84	46 43 83	01	08	
	γ Phœnicis	0 38 68	09	24	7	04	03 39 47	49 48 25	22	13	
	545.	56 20 14	06	08	52	06	02 20 44	55 29 43	01	08	
	33.	2 02 37 79	04	45	57	08	02 37 72	2 01 46 57	15	06	

a = + 538 c = 48.3

Chronometer correction at 1 40 = 51 089 + 016

W	39.	2 35 25 63	05	27	52	09	02 25 90	2 34 31 48	51 12		
	41.	39 11 56	05	30	57	07	02 11 78	38 20 42	36		
	547.	40 25 03	05	14	54	07	02 25 43	39 33 95	48		
	3 Formicis	45 56 06	06	04	62	05	02 56 69	45 05 19	70		
	46.	52 56 16	05	19	58	03	02 36 16	51 45 06	40		
	o Eridani.	55 28 87	06	15	69	02	02 29 65	54 38 31	34	05	
	τ Eridani.	59 01 25	05	05	57	00	02 01 70	58 10 44	26	13	
E	359.	3 07 01 88	01	11	55	03	02 00 88	3 06 09 11	47	08	
	549.	08 52 36	02	01	60	03	02 51 74	08 00 43	31	08	
	2 Arietis	10 16 52	01	46	56	04	02 15 47	09 24 10	35	04	
	ι Eridani.	16 58 67	02	19	72	00	03 58 07	16 06 68	39	09	
	53.	20 32 17	01	35	53	05	02 31 21	19 30 81	40	01	
	55.	26 27 82	01	38	53	09	02 26 81	25 35 46	41	02	
	B.A.C. 1106	30 36 27	02	32	83	11	03 35 64	29 44 21	43	04	

a = + 557 c = + 524

Chronometer correction at 3 00 = 51 393 + 013

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date, December 11th, 1903. Observer, F. W. O. WEEKS.

Clamp.	Star.	Transit over mean of threads.	Level.	Azimuth.	[illegible]	[illegible]	[illegible]	[illegible]	R. A.	Chronometer correction.	[illegible]
		h. m. s.	s.	s.		s.			h. m. s.	s.	s.
E	21	1 20 11 84	02	[illegible]	[illegible]	13	2 11 27		1 19 13 90	57 37	01
	γ Phœnicis	25 09 80	03	21	[illegible]	11	03 09 79		24 12 08	41	05
	22	27 19 52	01	43	47	10	02 18 71		26 21 39	·32	04
	α Eridani	35 06 20	04	55	85	06	04 05 96		34 08 72	24	12
	ν Piscium	37 24 82	02	37	45	05	02 24 05		36 26 73	32	04
	542	40 34 91	02	14	47	04	02 34 34		39 36 06	[illegible]	02
	25	41 18 29	0[illegible]	38	46	04	·02 17 49		40 20 06	43	07
	543	42 07 28	02	04	50	04	02 06 78		41 09 36	42	06
W	544	47 40 85	02	20	46	01	02 41 08		46 43 83	25	11
	ξ Phœnicis	50 44 83	03	28	66	00	03 45 71		49 48 23	48	12
	545	56 26 40	02	09	49	03	02 26 73		55 29 43	30	06
	33	2 02 43 98	02	52	48	06	02 43 84		2 01 46 56	28	08
	546	09 38 50	02	02	53	09	02 38 92		08 41 41	51	15
	φ Eridani	14 01 73	04	·39	73	11	03 02 67		13 05 42	25	11

a = ·618 c = ·450

Chronometer correction at 1h 50m = 57s·355 ± ·017

W	ι Arietis	2 54 42 09	02	52	51	11	02 42 15		2 53 44 40	57 75	00
	47	58 13 98	02	34	47	10	02 14 17		57 16 53	64	11
	ι Horologii	3 02 18 52	·03	65	95	08	04 20 13		3 01 22 28	·85	10
	359	07 07 17	01	50	50	06	02 07 20		06 09 41	79	04
	549	08 57 45	00	01	54	05	02 58 03		08 00 42	61	14
	ι Eridani	17 03 59	00	21	65	01	03 04 43		16 06 67	76	01
E	53	20 38 41	06	39	48	00	02 37 58		19 39 81	77	02
	54	22 57 62	05	40	48	01	02 56 76		21 59 01	75	00
	55	26 34 15	06	43	48	03	02 33 25		25 35 39	86	11
	B. A. C. 1106	30 42 28	10	·36	75	05	03 41 91		29 44 20	71	04
	10 Taurean	32 58 04	06	31	47	06	02 57 24		31 59 45	·79	04
	550	39 38 39	07	21	48	09	02 37 66		38 39 98	68	07
	551	43 42 44	07	06	52	11	02 41 80		42 44 07	73	02

a = ·629 c = ·473

Chronometer correction at 3h 20m = 57s·749 ± ·015

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date, December 17th, 1903. Observer: F. W. O. WELLS

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
E	544	1 48 20·71	·13	·19	·50	·27	·07				
	ζ Phœnicis	51 24·84	·19	·28	·73	·10	·02	20·23	1 46 43·78	1 36 45	·03
	545	57 06·18	·14	·08	·52	·09	·03	24·64	49 18·14	·50	·02
	33	2 03 23·03	·09	·51	·52	·06	·02	05·76	55 29·37	·39	·09
	546	10 18·39	·16	·02	·52	·03	·02	23·00	2 01 46·52	·48	·00
	φ Eridani	14 42·03	·20	·38	·78	·00	·02	17·98	08 41·35	·63	·15
W	δ Hydri	21 37·27	·16	1·09	1·36	·02	·03	41·78	13 05·33	·45	·03
	37	24 40·37	·06	·37	·49	·05	·05	39·78	20 03·30	·48	·09
	τ Ceti	32 27·32	·07	·24	·49	·07	·02	40·46	23 04·05	·41	·07
	355	34 59·44	·05	·50	·52	·10	·02	27·52	30 50·96	·56	·08
	39	36 10·89	·07	·29	·49	·11	·02	59·38	33 22·85	·53	·05
	41	39 56·70	·07	·32	·49	·12	·02	11·02	34 34·45	·57	·09
	547	41 10·09	·08	·16	·50	·13	·02	56·79	38 20·39	·40	·08
						·14	·02	10·35	39 33·91	·44	·04

a = ·603 c = ·486

Chronometer correction at $2^h\ 10^m$ $1^m 36^s\cdot485$ ·015

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date, December 18th, 1903. Observer: F. W. O. WERRY.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
E	α Hydri	1 57 28·73	·15	·59	1·27	·27	·04	28·44	1 55 44·84	1 43·60	·11
	353	2 13 56·27	·08	·19	·60	·20	·02	55·74	2 12 12·31	·43	·06
	α Fornacis	19 53·48	·07	·05	·65	·18	·02	53·01	18 09·58	·43	·06
	τ Baleine	29 16·73	·09	·12	·62	·14	·02	16·20	27 32·88	·32	·17
	355	35 07·31	·05	·41	·64	·11	·02	06·40	33 22·84	·56	·07
W	54	3 23 42·26	·04	·32	·60	·11	·02	42·45	3 21 59·01	·44	·05
	B.A.C. 1106	31 26·49	·08	·29	·94	·14	·03	27·63	29 44·12	·51	·02
	550	40 23·22	·05	·17	·60	·18	·02	23·50	38 39·99	·51	·02
	61	43 31·12	·03	·44	·65	·0	·02	31·44	41 47·87	·57	·08
	552	55 17·26	·05	·14	·61	·25	·02	17·51	53 34·04	·47	·02
	66	57 06·32	·04	·34	·61	·26	·02	06·35	55 22·80	·55	·06
	δ Reticule	58 57·09	·09	·58	1·25	·27	·04	58·70	57 15·27	·43	·06

a = ·505 c = ·594

Chronometer correction at $3^h\ 00$ $1^m\ 43^s\cdot486$ ·016

TRANSIT OBSERVATIONS.

Station: NORFOLK ISLAND. Date, December 19th, 1903. Observer: F. W. O. WERRY.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	r.
		h. m. s.	s.	s.	s.	r = s. 25	s.		h. m. s.	m s.	s.
W	21	1 21 03·22	-·05	·18	-·55	-·16	·02	03·78	1 19 13·82	1 49·96	·03
	22	28 10·95	-·04	·37	·56	-·13	·02	11·29	26 21·32	·97	·02
	α Eridani	35 56·79	-·09	-·48	-1·02	·10	·04	58·44	34 08·51	·93	·06
	ν Piscium	38 16·37	·04	·32	-·55	-·09	·02	16·71	36 26·67	50·04	-·05
	542	41 26·34	-·06	·12	-·57	-·08	·02	26·91	39 36·88	·03	-·04
	25	42 09·70	-·05	·33	·55	-·07	·02	10·02	40 20·00	·02	-·03
E	α Hydri	57 35·17	-·24	-·61	1·16	-·01	·04	34·83	55 44·80	·03	-·04
	37	2 24 54·85	-·11	·32	·55	-·10	·02	53·97	2 22 64·03	49·94	·05
	τ Baleine	29 23·45	-·14	·13	·57	-·12	·02	22·75	27 32·87	·88	·14
	ν Ceti	32 41·85	-·13	·21	·55	-·13	·02	41·07	30 50·94	50·13	-·14
	355	35 13·82	-·10	·43	·58	-·15	·02	12·74	33 22·83	49·91	·08
	39	36 25·26	-·12	·25	·55	-·15	·02	24·41	34 34·45	·96	·03
	41	40 11·30	-·12	·28	·55	-·17	·02	10·40	38 20·38	50·02	-·03

$a = -$ ·528 $c = -$ ·546

Chronometer correction at $2^h\ 00^m = -1^m\ 49$·986 -·015

E	53	3 21 30·95	-·06	·34	·49	-·12	·02	30·28	3 19 39·80	1 50·48	-·04
	54	23 50·13	-·06	·35	·49	-·11	-·02	49·44	21 59·00	·44	·00
	55	27 26·59	-·06	-·38	-·50	-·10	·02	25·85	25 35·39	·46	·02
	10 Taurean	33 50·57	-·07	-·27	-·49	+·07	-·02	49·93	31 59·45	·48	-·04
	550	40 30·93	-·08	·18	-·50	-·04	·02	30·35	38 39·98	·37	·07
	551	44 34·98	-·09	-·06	-·53	+·02	·02	34·48	42 44·06	·42	·02
W	552	55 24·26	-·01	·15	+·50	-·02	·02	24·58	53 31·03	·55	-·11
	66	7 13·13		·37	+·50	·03	·02	13·22	55 22·80	·42	·02
	366	4 09 02·13		·33	+·49	·08	·02	02·20	4 07 11·83	·37	·07
	α Horologii	12 40·25		·8	+·66	·09	·03	41·61	10 50·60	·41	·03
	71	19 15·62		·2	+·51	-·12	·02	15·58	17 25·12	·46	-·02
	d Eridani	22 17·08			-·06	+·59	-·13	-·02	17·61	20 27·14	·47	-·03

a -·556 $c = -$·488

Chronometer correction at $3^h\ 50^m = -1^m\ 50$·444 -·018

TRANSIT OBSERVATIONS.

Station: Doubtless Bay. Date, December 5th, 1903. Observer: Otto Klotz.

Clamp.	Star.	Transit over mean of threads	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.
E	ω Piscium	23 54 39·77	·01	·30	·41	·49			23 54 23·07	16·38
	2 Ceti	59 05·89	·02	·14	·42	·42	·02	39·45	58 49·32	·33
	γ Pegasi	24 08 34·73	·01	·35	·42	·36	·02	05·65	24 08 17·86	·37
	ζ Toucani	15 20·54	·04	·55	·97	·30	·02	31·23	15 04·01	·28
	ζ Hydri	20 58·90	·06	1·44	1·91	·25	·04	20·29	20 42·09	·40
	12 Ceti	25 25·56	·01	·23	·46	·26	·08	58·49	25 08·63	·43
	ζ Ceti	39 03·40	·01	·13	·42	·16	·02	25·96	38 46·45	·42
W	α Sculptoris	54 15·46	·36	·04	·46	·07	·02	15·43	53 59·00	·43
	ε Piscium	58 14·76	·23	·30	·41	·11	·02	14·51	57 58·14	·37
	ζ Phœnicis	25 02 04·41	·45	·14	·59	·14	·02	04·53	25 01 48·15	·38
	ζ Ceti	19 30·69	·30	·20	·41	·28	·02	30·30	19 13·97	·33
	γ Phœnicis	24 28·65	·13	·09	·56	·32	·02	28·53	24 12·18	·35
	η Piscium	26 38·29	·21	·35	·42	·33	·02	37·80	26 21·47	·33
	α Eridani	34 25·20	·54	·32	·75	·42	·03	25·28	34 08·89	·39

a = −·448 c = ·403

Chronometer correction at 24h 45m 16s·371 ·009

TRANSIT OBSERVATIONS.

Station: Doubtless Bay. Date, December 6th, 1903. Observer: Otto Klotz.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer corr.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.
E	2 Ceti	23 59 19·81	·17	·14	·51	·49			23 58 49·31	30·44
	γ Pegasi	24 08 48·70	·11	·35	·50	·44	·02	19·75	24 08 17·86	·43
	ι Ceti	15 03·09	·15	·19	·49	·35	·02	48·29	14 32·32	·53
	ζ Hydri	21 12·57	·59	1·43	2·31	·31	·02	02·85	20 42·00	·46
	ζ Ceti	39 17·36	·17	·13	·51	·26	·08	12·46	38 46·46	·52
	δ Piscium	44 13·65	·13	·30	·50	·11	·02	16·98	43 42·50	·53
	20 Ceti	48 37·58	·15	·24	·49	·07	·02	13·03	48 06·47	·55
W	α Sculptoris	54 29·30	·23	·05	·56	·04	·02	37·02	53 58·90	·56
	ε Piscium	58 28·64	·15	·30	·49	·01	·02	29·55	57 58·13	·49
	ζ Phœnicis	25 02 18·21	·29	·14	·72	·04	·02	28·62	25 01 48·13	·56
	η Piscium	09 13·98	·15	·30	·49	·07	·02	13·69	08 43·45	·42
	α Eridani	34 38·81	·34	·32	·91	·13	·02	13·87	34 08·87	·46
	ο Piscium	40 50·93	·15	·31	·49	·33	·04	39·33	40 20·12	·44
	ι Ceti	47 14·66	·19	·19	·50	·38	·02	50·56	46 43·92	·40
						·44	·02	14·32		

a = −·445 c = ·488

Chronometer correction at 24h 53m 30s·486 ·011

TRANSIT OBSERVATIONS.

Station: Doubtless Bay. Date, December 7th, 1903. Observer: Otto Klotz.

Clamp.	Star.	Transit over mean of threads.	Level and azimuth equality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. to asst.	R. A.	Chronometer correction.	v.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	β Hydri	0 21 25·08	41	1·23	1·93	-·29	·08	25·00	0 20 41·01	43·09	·00
	12 Ceti	25 51·92	10	20	41	-·26	·02	51·65	25 08·40	·05	·04
	β Ceti	39 29·73	12	11	33	·16	·02	29·45	38 46·45	·00	·09
	δ Piscium	44 26·10	09	·26	41	-·12	·02	25·62	43 42·49	·13	·04
	26. Ceti	48 49·97	10	21	·41	-·09	·02	49·[illegible]	48 06·46	·06	·05
	α Sculptoris	54 42·45	11	·04	47	·05	·02	42·11	53 58·98	·13	·04
	ε Piscium	58 41·84	09	26	41	-·02	·02	41·26	57 58·12	·14	·05
W	α^1 Piscium	1 09 26·60	15	26	41	·06	·02	26·52	1 08 43·44	·08	·01
	θ Ceti	19 57·13	18	17	41	·13	·02	57·04	19 13·95	·09	·00
	γ Phœnicis	24 55·12	27	08	57	·17	·02	55·33	24 12·15	·16	·07
	η Piscium	27 04·75	13	30	42	·19	·02	04·53	26 21·44	·09	·00
	α Eridani	34 51·47	34	28	76	·24	·04	51·89	34 08·84	·05	·04
	ν Piscium	37 10·14	15	27	41	·26	·02	09·87	36 26·75	·12	·03
	ο Piscium	41 03·52	15	27	41	·29	·02	03·20	40 20·11	·09	·00

σ = ·383 σ = ·407

Chronometer correction at $1^h\ 01^m$ = 43s·091 ± ·009

TRANSIT OBSERVATIONS.

Station: Doubtless Bay. Date, December 9th, 1903. Observer: Otto Klotz.

Clamp.	Star.	Transit over mean of threads.	Level and azimuth equality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. to asst.	R. A.	Chronometer correction.	v.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
E	β Ceti	0 39 52·42	13	15	·47	-·57	·02	52·48	0 38 46·42	1 06,06	·10
	δ Piscium	44 48·76	10	33	45	-·52	·02	48·58	43 42·47	·11	·05
	α Sculptoris	55 05·17	15	05	51	-·45	·02	05·19	53 58·95	·24	·08
	β Phœnicis	1 02 54·22	·18	15	66	-·41	·02	54·28	1 01 48·07	·21	·05
	α Eridani	35 15·11	·22	35	84	-·17	·03	14·98	34 08·79	·19	·03
	ο Piscium	41 26·76	·09	34	45	-·13	·02	26·17	40 20·10	·07	·09
W	κ Fornacis	2 19 15·74	16	10	49	·13	·02	15·82	2 18 09·66	·16	·00
	δ Hydri	21 08·25	35	77	1·25	·15	·05	09·72	20 03·63	·09	·07
	ϵ^2 Ceti	24 10·41	11	33	45	·17	·02	10·23	23 04·10	·13	·03
	θ Eridani	55 44·48	18	·06	59	·39	·02	44·54	54 38·32	·22	·06
	α Ceti	58 23·28	11	31	45	·41	·02	22·88	57 16·56	·29	·13
	ο Tauri	3 20 46·60	11	34	45	·57	·02	46·01	3 19 39·82	·19	·03

σ = ·489 σ = ·446

Chronometer correction at $2^h\ 60^m$ = 1^m·06 ± ·04 ± ·016

TRANSIT OBSERVATIONS.

Station: Doubtless Bay. Date, December 10th, 1903. Observer: Otto Klotz

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr transit.	R. A	Chronometer correction
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s. s.
E	β Hydri	0 21 59·41	45	1·06	1·83	42				
	β Ceti	40 04 25	13	10	41	31	08 59 32		0 20 41 64	1 17 68 02
	δ Piscium	45 00 54	10	22	39	·18	02 04 03		38 46 41	62 ·04
	20 Ceti	49 24 44	11	18	39	·14	02 00 15		43 42 46	69 03
	α Sculptoris	55 16 88	15	03	45	·11	02 24·07		48 06 43	64 02
	ε Piscium	59 16 23	10	·22	39	07	02 16 60		53 58 93	·67 ·01
	γ Phœnicis	1 03 05 95	·18	·10	·37	04	02 15 74		57 58 09	·65 ·01
W	θ Ceti	20 31 60	13	15	39	·01	02 05 65		1 01 18 05	60 06
	γ Phœnicis	25 29 52	19	07	54	10	02 31 59		19 13 93	66 00
	η Piscium	27 39 23	10	26	·40	15	02 29 77		24 12 10	67 01
	α Eridani	35 25 94	26	24	·72	15	03 39 09		26 21 43	66 ·00
	ε Piscium	37 14 57	·10	·21	39	21	02 26 41		34 08 76	65 ·01
	ι Ceti	48 01 73	14	·14	39	22	02 44 41		36 26 75	66 00
	β Arietis	50 39·01	·09	29	·41	30	02 01 52		46 43 89	63 ·03
						31	02 38 71		49 21 01	70 ·01

a = ·3 90 c = ·387

Chronometer correction at 1h 05m 1m 17·657 ·005

W	σ Arietis	2 47 30 97	·13	32	41	34	02 31 25		2 46 12 49	1 18 76	·08
	θ Eridani	55 56 23	25	·05	52	·29	02 56 82		54 38 30	52	16
	α Ceti	58 35 05	15	25	·[illegible]	·27	02 35 30		57 16 58	72	·04
	α Horologii	3 02 40 04	·34	·34	·[illegible]	·24	04 41·03		3 01 22 30	73	·05
	α Tauri	20 58 48	14	28	40	·11	02 58 55		19 39 82	73	·05
	ε Eridani	29 44 01	17	17	·40	·05	02 44·10		28 25·41	69	·01
E	δ Eridani	39 59 19	·08	17	40	02	02 58 66		38 39 98	68	00
	γ Hydri	50 05 76	26	·97	1 48	10	07 05 34		48 46 64	70	·02
	γ^1 Eridani	54 53 36		15	41	13	02 52 75		53 34 05	70	02
	A^1 Tauri	4 00 22 01		36	43	17	·02 21 08		59 02 41	·67	01
	α^1 Eridani	08 31 21	[illegible]	19	40	22	·02 30 46		4 07 11 82	64	04
	ε Tauri	24 21 64	06	·35	42	34	02 20 57		22 61·89	68	00

a = ·405 c = 395

Chronometer correction at 3h 36m 1m 18·683 ·013

TRANSIT OBSERVATIONS.

Station: Doubtless Bay. Date, December 11th, 1903 Observer: Otto Klotz.

Clamp.	Star.	Transit over mean of threads	Level and inequality of pivots.	Azimuth.	Collimation	Rate.	Aberration.	Seconds of cent. transit.	R. A.	Chronometer correction.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s. s
E	ι Ceti	0 16 00·99	·26	·15	·36	− ·27	·02	00·99	0 14 32·27	1 28·72 ·00
	δ Hydri	22 09·74	+ ·99	− 1·10	1·70	+ ·23	·08	10·28	20 41·55	·73 ·01
	12 Ceti	26 37·31	+ ·25	·17	·36	+ ·21	·02	37·22	25 08·56	·66 ·06
	β Ceti	40 15·16	+ ·29	·10	·38	+ ·11	·02	15·06	38 46·40	·66 ·06
	δ Piscium	45 11·54	+ ·21	·23	·36	+ ·08	·02	11·22	43 42·45	·77 − ·05
	α Sculptoris	55 27·81	+ ·33	·03	·41	+ ·02	·02	27·70	53 58·92	·75 − ·06
	ε Piscium	59 27·30	+ ·21	·23	·36	·02	·02	26·88	57 58·08	·80 ·08
W	β Phœnicis	1 03 16·10	+ ·06	− ·11	+ ·53	+ ·04	·03	16·73	1 01 48·03	·70 ·02
	β Piscium	10 12·06	+ ·03	·23	+ ·36	·09	·02	12·11	08 43·41	·70 ·02
	θ Ceti	20 42·61	+ ·03	·15	+ ·36	·15	·02	42·68	19 13·91	·77 − ·05
	γ Phœnicis	25 46·45	+ ·05	− ·07	+ ·50	·18	·02	46·87	24 12·08	·79 − ·07
	η Piscium	27 50·25	+ ·02	·27	+ ·37	·20	·02	50·15	26 21·42	·73 ·01
	α Eridani	35 36·74	·06	·25	·67	·26	·04	37·42	34 08·73	·69 ·03
	ε Piscium	37 55·51	·03	·22	·35	·27	·02	55·39	36 26·72	·67 ·05

t = + ·341 e = + ·360

Chronometer correction at 6h 57m 1m 28s·725 + ·010

TRANSIT OBSERVATIONS.

Station: DOUBTLESS BAY. Date, December 12th, 1903. Observer: OTTO KLOTZ

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Second-of-clock transit	R. A.	Chronometer correction.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s. s.
E	γ Pegasi	0 09 58 46	13	·37	·41	·34	02 58 23		0 08 17 88	1 40 35 08
	ι Ceti	16 12 80	18	·15	40	·29	02 12 70		14 32 25	45 ·02
	ζ Hydri	22 21 76	69	-1·13	1 88	25	08 21 87		20 41 45	·42 01
	12 Ceti	26 49 19	17	·18	40	22	02 48 98		25 08 55	43 00
	ζ Ceti	40 26 98	20	11	42	·13	02 26 76		38 46 39	37 06
	δ Piscium	45 23 36	15	·24	40	10	02 22·95		43 42 44	51 ·08
	α Sculptoris	55 39 65	23	04	·46	·02	02 39 38		53 58 91	47 ·04
W	ζ Phoenicis	1 03 28 01	16	-·11	·59	02	03 28·50		1 01 48 00	50 ·07
	C^1 Piscium	10 23 82	09	23	·40	07	·02 23 81		08 43 39	42 01
	γ Phoenicis	25 52 23	16	·07	·55	18	02 52 49		24 12 06	43 ·00
	η Piscium	28 01 97	08	·28	·41	19	02 01 81		26 21 40	·41 02
	α Eridani	35 48 61	20	·25	·74	·24	·04 49 12		34 08 71	41 02
	ν Piscium	38 97 31	09	22	·40	26	02 07·12		36 26 71	·41 02
	C Ceti	48 24 46	11	15	·41	34	·02 24 25		46 43 87	38 05

a = -·350 c = ·398

Chronometer correction at 0^h 59^m 1^m 40·426 ·009

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Second-of-clock transit	R. A.	Chronometer correction.
W	α Horologii	3 03 02 71	42	·34	·92	·31	03 03 83		3 01 22 26	1 41·57 ·02
	δ Arietis	08 50 73	14	·35	·49	·27	02 56 98		06 09 43	·55 ·00
	π^1 Arietis	17 23·52	14	·35	·49	·22	·02 23·72		15 42 18	·54 01
	f Tauri	27 16 81	16	·30	·47	·15	·02 16 95		25 35 41	·54 01
	ε Eridani	30 06 70	21	·17	·46	·13	02 06 89		28 25 41	48 07
	π^2 Eridani	31 15 07	24	·10	·50	·12	02 15·33		29 33 76	57 ·02
	η Tauri	43 29 48	13	37	·50	·04	·02 29·50		41 47 90	60 ·05
E	A^1 Tauri	4 00 44 79	09	·36	·50	·07	·02	43 93	59 02 42	·51 ·04
	ω^1 Tauri	05 18 08	·08	·35	·49	10	·02	17 20	4 03 35 58	·62 ·07
	o^1 Eridani	08 53·99	13	18	·46	13	02	53 33	07 11 82	51 ·04
	α Reticuli	14 55·45	20	·41	-1·00	·17	·04	54 94	13 13 36	·58 ·03
	ε Tauri	24 44 46	09	·35	-·49	-·23	·02	43·46	23 01·90	56 01
	α Tauri	32 08 47	10	·33	·48	·20	·02	07 45	30 25 95	50 ·07
	53 Eridani	35 30 51	15	·14	-·47	·31	-·02	20 72	33 48 13	59 ·07

a = -·402 c = ·460

Chronometer correction at 3^h 49^m = 1^m 41·551 ·010

TRANSIT OBSERVATIONS.

Station: DOUBTLESS BAY. Date, December 17th, 1903. Observer: OTTO KLOTZ.

Chanp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
E.	ξ Hydri..	0 23 19·89	-·42	1·00	1·74	-·30	·08	19·79	0 20 40·98	2 38·81	·07
	δ Piscium..	46 21·68	·10	·21	·37	-·18	·02	21·36	43 42·39	·97	-·09
	α Sculptoris..	56 37·93	·14	·03	·42	-·13	·02	37·73	53 58·84	·89	·01
	ε Piscium..	1 00 37·40	·10	·21	·37	-·10	·02	37·00	57 58·03	·97	·09
	ξ Phœnicis.	04 27·10	-·17	·10	·54	+·08	·02	26·89	1 01 47·91	·98	·10
	c^3 Piscium..	11 22·70	-·10	·21	·37	-·04	·02	22·24	08 43·35	·89	·01
	θ Ceti..	21 53·19	-·11	·14	·37	-·01	·02	52·76	19 13·85	·91	·03
W	ο Piscium..	42 58·92	-·12	·22	-·37	-·13	·02	58·80	40 20·03	·77	·11
	ζ Ceti..	49 22·64	·16	·13	-·38	·17	·02	22·54	46 43·83	·71	·17
	ξ Arietis..	52 00·06	·10	·27	-·39	·18	·02	59·88	49 20·96	·92	-·04
	α Hydri..	58 23·40	·32	-·30	-·79	·21	·04	23·92	55 44·87	39·05	-·17
	α Arietis..	2 04 25·62	·10	·29	-·40	·25	·02	25·36	2 01 46·55	38·81	·07
	δ_2 Ceti..	14 51·42	·15	·15	-·37	·30	·02	51·17	12 12·33	·84	·04
	κ Form	20 48·63	·18	·06	·41	·33	·02	48·45	18 09·59	·86	·02

a = -·310 c = ·369

Chronometer correction at 1^h 19^m = 2^m 38·883 - ·018

W	δ Eridani..	3 41 19·62	·25	·18	-·37	-·25	·02	19·79	3 38 39·98	2 39·81	·07
	γ Hydri..	51 24·65	·79	-·98	1·36	-·19	·06	26·33	48 46·40	·93	·05
	o^1 Eridani..	56 13·85	-·26	·15	-·37	+·17	·02	13·96	53 34·06	·90	·02
	γ^1 Tauri..	4 01 42·31	·16	·37	-·39	-·14	·02	42·29	58 62·44	·85	·03
	λ^1 Tauri..	06 15·50	·17	·35	-·38	-·11	·02	15·45	4 03 35·60	·85	·03
	o^2 Eridani.	09 51·68	·24	·19	-·37	·09	·02	51·69	07 11·84	·85	·03
E	α Doradûs..	34 37·41	·04	-·24	·64	·04	·03	36·90	31 57·17	·73	·15
	π^1 Orionis..	47 19·67	-·02	-·27	·37	·12	·02	18·87	44 38·92	·95	-·07
	ε Leporis..	5 04 05·79	·02	-·09	·39	·21	·02	05·06	5 01 25·12	·94	-·06
	ξ Eridani..	05 49·82	-·02	·20	·36	-·22	·02	49·00	03 09·06	·94	-·06
	α Leporis..	11 19·17	·02	·13	·38	·25	·02	18·37	08 38·39	·98	·10

-·408 c = ·363

Chronometer correction at 4^h 26^m = 2^m 39·885 - ·018

TRANSIT OBSERVATIONS.

Station: Doubtless Bay. Date, December 18th, 1903. Observer: Otto Klotz.

Clamp.	Star.	Transit over mean of threads.	Level and Collimation.	Azimuth.	Collimation.	Rate.	Aberration.	Reversals of over transit.	R. A.	Chronometer Correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	
E	β Hydri	0 23 29·87	+ ·65	1·17	1·76	·37	·08	30 12	0 29 40·88	2 49·24	·01
	β Ceti	41 35·66	·19	·11	·39	·15	·02	35 48	38 46·31	·17	·06
	δ Piscium	46 32·00	·14	·25	·38	·12	·02	31 61	43 42·37	·24	·01
	20 Ceti	50 55·87	·16	·26	·37	·10	·02	55 54	48 06·35	·19	·04
	α Sculptoris	56 48·29	·21	·04	·43	·06	·02	48 07	53 58·82	·19	·04
	ε Piscium	1 00 47·73	·14	·25	·38	·04	·02	47 26	57 58·01	·25	·02
	c^1 Piscium	11 33·17	·14	·24	·38	·03	·02	32 60	1 08 43·36	·18	·05
W	θ Ceti	22 03·06	·12	·16	·37	·10	·02	03 03	19 13·84	·19	·04
	γ Phœnicis	27 00·90	·18	·08	·52	·13	·02	01 17	24 11·95	·12	·01
	η Piscium	29 10·78	·09	·29	·38	·14	·02	10 62	26 21·35	·15	·01
	α Eridani	36 57·29	·22	·26	·70	·18	·03	57 82	34 08·54	·19	·05
	ο Piscium	39 16·06	·10	·23	·37	·20	·02	15 88	36 26·67	·21	·02
	ν Ceti	43 09·49	·09	·25	·38	·23	·02	09 28	40 20·02	·26	·03
		58 18·76	·13	·09	·40	·32	·02	18 60	55 29·39	·21	·02

$a = +·362$ $c = +37·3$

Chronometer correction at $1^h\ 06^m$ $2^m\ 49^s·234 - ·007$

W	f Tauri	3 28 25·48	·08	·27	·43	·25	·02	25 79	3 25 35·42	2 50·37	·01
	ε Eridani	31 15·37	·10	·15	·42	·23	·02	15 75	28 25·40	·35	·01
	π^5 Eridani	32 23·70	·12	·09	·45	·22	·02	24 14	29 33·77	·37	·01
	δ Eridani	41 29·09	·11	·15	·43	·17	·02	30 31	38 39·53	·38	·02
	γ Hydri	51 34·58	·33	·85	1·56	·11	·06	36 71	48 46·36	·35	·01
	γ^1 Eridani	56 24·16	·11	·13	·43	·07	·02	24 40	53 34·06	·34	·02
E	A^1 Tauri	4 01 52·75	·07	·32	·45	·04	·02	52 83	59 02·44	·39	·03
	α Reticuli	16 04·02	·35	·36	·91	·05	·04	63 75	4 13 13·29	·44	·08
	ε Tauri	25 53·03	·11	·31	·44	·10	·02	52 27	23 01·93	·34	·02
	α Doradûs	34 47·82	·29	·21	·73	·16	·03	47 40	31 57·16	·24	·12
	53 Eridani	36 39·12	·17	·13	·43	·17	·02	38 54	33 48·16	·38	·02
	τ Tauri	39 21·55	·10	·32	·45	·19	·02	20 67	36 30·32	·35	·01
	α Eridani	43 34·36	·15	·19	·42	·22	·02	33 56	40 43·32	·34	·02
	π^1 Orionis	47 30·11	·13	·24	·42	·25	·02	29 51	44 38·02	·39	·03

$a = +·356$ $c = +·417$

Chronometer correction at $4^h\ 08^m$ $2^m\ 50^s·360 - ·009$

TRANSIT OBSERVATIONS

Station: [illegible] BAY. Date, December 19th, 1903. Observer: OTTO KLOTZ

Clamp.	Star.	Transit over mean of threads.	Level and collimation passes.	Azimuth.	Collimation.	Rate.	Aberration.	Zero of transit.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
E	θ Eridani	2 57 39 41	10	04	54	40 33	02	29 32	2 54 38 21	3 01 11	20
	α Ceti	3 00 18 03	06	18	41	31	02	17 79	57 16 56	23	08
	5 Arietis	09 11 22	05	24	43	25	02	10 83	3 00 09 43	30	12
	τ Tauri	28 37 27	06	21	42	13	02	36 81	25 35 42	30	08
	ι Eridani	31 27 05	07	12	41	11	02	26 68	28 25 39	29	02
	κ Eridani	32 35 44	08	07	41	10	02	35 09	29 33 76	33	02
	5 Eridani	41 41 65	07	12	42	04	02	41 20	38 39 93	27	01
W	γ Hydri	51 45 88	51	07	1 54	03	06	47 49	48 46 31	18	13
	γ¹ Eridani	56 35 26	17	10	42	06	02	35 33	53 34 06	27	04
	λ Tauri	4 02 03 82	10	25	44	10	02	03 79	59 02 44	35	04
	ω^2 Tauri	06 37 07	11	24	43	13	02	37 00	4 03 35 60	40	09
	o^1 Eridani	10 13 21	15	13	41	15	02	13 16	07 11 84	32	01
	τ Tauri	26 03 48	11	21	43	26	02	03 28	23 01 94	34	03
	53 Eridani	36 49 77	17	10	42	33	02	49 57	33 48 16	41	10

$r = \cdot 281$ $s = \cdot 410$

Chronometer correction: at $3^h\ 47^m$ $3^m\ 01 \cdot 306 \pm \cdot 020$

TRANSIT OBSERVATIONS.

Station: WELLINGTON. Date, December 6th, 1903. Observer, THOS. KIN

Group	Star.	Transit over mean of threads.	Level and Collimation Corrections.	Azimuth.	Collimation.	Rate.	Aberration.	Zenith-distance of star.	R. A.	Chronometer correction.
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.
E	δ Piscium	0 43 47 32	20	39	37	23	02 48 03		0 43 42 50	5 53 0
	ι Phœnicis	1 01 52 80	43	08	54	15	02 53 52		1 01 48 13	39 11
	α¹ Piscium	08 48 20	20	39	37	12	02 49 02		08 43 45	57 07
	θ Ceti	19 18 53	-24	28	37	09	02 19 31		19 13 06	35 15
	γ Piscium	26 26 30	-15	45	38	06	02 27 20		26 21 46	74 24
	ε Eridani	34 13 44	-5	28	69	01	03 14 34		34 08 87	47 03
W	ζ Ceti	46 49 16	17	39	40	04	02 49 44		46 43 92	52 02
	α Hydri	55 51 32	06	39	79	08	03 50 85		55 45 20	65 15
	ι Ceti	2 08 00 56	-22	-40	37	13	02 00 92		2 07 55 47	45 05
	λ Fornacis	18 14 79	36	-17	41	17	02 15 06		18 09 68	38 12
	ν Ceti	30 55 93	23	38	37	22	02 56 37		30 50 99	38 12

x = -522 c = -370

Chronometer correction at 1h 37m 5s 496 -031

W	γ Hydri	3 48 52 86	-1 25	88	1 22	22	06 51 73		3 48 46 76	4 97 -13
	A¹ Tauri	59 07 09	-18	-49	35	17	02 07 22		59 02 39	83 01
	α¹ Eridani	4 07 16 49	-31	-29	33	14	02 16 60		4 07 11 80	80 -04
	γ Tauri	14 25 30	-21	46	34	11	02 25 50		14 20 95	55 29
	ε Tauri	23 06 53	-20	47	35	07	02 06 76		23 01 86	90 06
	α Tauri	30 30 34	-21	-46	34	04	02 30 61		30 25 91	70 14
E	ι Aurigæ	50 49 73	-10	-59	-39	-04	02 50 83		50 45 92	-01 -07
	ε Leporis	5 01 29 24	-31	-18	-35	05	02 30 11		5 01 25 04	5 07 -23
	ζ Orionis	10 00 70	-26	-28	-33	12	02 01 67		09 56 59	-08 -24
	δ Doradûs	32 53 74	62	40	-71	-22	03 54 86		32 50 29	4 57 27

x = -512 c = -326

Chronometer correction at 4h 40m 4s 840 -040

TRANSIT OBSERVATIONS.

Station WELLINGTON. Date December 7th, 1903. Observer THOS. KING.

Clock	Star	Transit over mean of threads	Level and Azimuth	Azimuth	Collimation	Rate	Aberration	Seconds of transit	R. A.	Chronometer correction	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	Piscium	1 26 24 11	29	25	35	07	02	24 79	1 26 21 45	1 34	11
	Eridani	34 13 04	60	14	61	06	03	12 05	34 08 84	21	21
	Arietis	49 25 46	18	25	37	04	[illegible]	24 30	49 21 03	17	07
	Ceti	55 31 94	34	10	37	03	[illegible]	32 70	55 29 47	23	07
	Trianguli	2 05 53 33	10	31	42	02	03	54 12	2 05 51 01	11	09
W	Ceti	30 54 19	23	19	34	02	02	54 27	30 50 99	28	08
	Ceti	38 23 43	24	19	34	03	02	23 53	38 20 43	10	10
	Arietis	46 15 51	19	23	35	05	02	15 64	12 50	14	06
	Arietis	53 47 56	17	24	37	06	02	47 65	44 11	24	04
	Horologii	3 01 25 69	67	17	69	07	03	25 52	3 01 22 36	16	04

a = 265 c = 343

Chronometer correction at 2h 14m 3s 195+ 024

W	ϵ Persei	3 51 29 30	08	48	39	06	02	29 39	3 51 29 27	3 12	05
	A Tauri	59 05 37	20	36	32	05	02	05 54	59 02 40	14	05
	α Tauri	4 03 38 57	21	34	32	04	02	38 74	4 03 35 56	18	01
	α Reticuli	13 16 82	82	40	65	03	03	16 63	13 13 41	22	05
	ϵ Tauri	23 04 82	21	34	32	01	02	05 02	23 01 87	15	02
E	α Doradus	31 59 42	58	46	52	06	02	60 34	31 57 29	14	05
	α Eridani	40 45 70	27	23	30	02	02	46 50	40 43 26	24	07
	π^1 Orionis	44 41 24	17	28	30	02	02	41 99	44 38 85	14	03
	Aurigæ	49 48 33	11	43	35	03	02	49 23	50 45 93	30	13
	ζ Orionis	5 09 58 83	30	25	30	06	02	59 67	5 09 56 61	06	11

a = 375 c = 298

Chronometer correction at 4h 30m 3s 165+ 022

TRANSIT OBSERVATIONS.

Station WELLINGTON. Date, December 11th, 1903. Observer THOS. KING.

Clock	Star	Transit over mean of threads	Level and Azimuth	Azimuth	Collimation	Rate	Aberration	Seconds of transit	R. A.	Chronometer correction	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	s.	s.
E	α Eridani	1 34 06 72	53	10	55	07	03	07 60	1 34 08 74	1 14	17
	o Piscium	40 18 73	26	11	36	06	02	19 32	40 20 08	0 76	26
	β Arietis	49 19 40	15	18	31	05	02	19 97	49 21 00	1 03	01
	ι^1 Ceti	2 07 53 80	19	15	30	02	02	54 40	2 07 55 45	1 05	03
W	ν Ceti.	30 49 79	23	14	29	04	02	49 86	30 50 98	1 12	10
	γ^2 Ceti.	38 19 30	26	14	29	02	02	19 41	38 20 42	1 01	01
	θ Eridani.	54 37 11	47	00	39	05	02	37 22	54 38 29	1 07	05
	α Horologii..	3 01 21 36	68	13	59	06	03	21 35	3 01 22 28	0 93	09
	δ Arietis	06 08 26	19	18	31	07	02	08 37	06 09 44	1 07	05

a = 196 c = 293.

Chronometer correction at 2h 20m 1s 021 + 031

TRANSIT OBSERVATIONS

Station: Wellington. Date, December 12th, 1903. Observer: Thos. Ke

Class	Star	Transit over mean of clock	Level	Azimuth	Collimation	Rate	Mean time of transit	R. A.	Chronometer correction
		h m s	″	″	″	s	h	h	s
F	α Ceti	1 46 40 01	20	16	25	09	02 40 56	1 46 43 87	3 31
	Hydri	55 41 01	46	24	35	07	03 41 71	55 45 02	31
	Arietis	2 01 42 53	11	31	28	06	02 43 15	2 01 46 59	44
	ζ Ceti	12 08 46	19	18	26	04	02 09 03	12 12 36	33
	Fornacis	18 05 56	24	10	29	03	02 06 14	18 09 63	49
W	α Ceti	30 47 44	24	25	26	00	02 47 63	30 50 97	34
	Ceti	38 16 89	25	12	26	01	02 17 69	38 20 41	32
	Arietis	46 08 00	21	27	25	03	02 09 12	46 12 48	39
	Horologii	3 01 18 89	67	20	52	06	03 18 87	3 01 22 26	39
	Arietis	15 38 57	17	30	28	09	02 38 85	15 42 18	35

σ = ·315 σ = ·264

Chronometer correction at 2h 31m 3s·362 ± ·017

Class	Star	Transit over mean of clock	Level	Azimuth	Collimation	Rate	Mean time of transit	R. A.	Chronometer correction
W	ζ Tauri	4 22 58 47	21	15	30	09	02 58 42	4 23 01 90	3 48
	α Doradûs	31 53 52	67	07	49	07	03 53 53	31 57 19	66
	Eridani	40 39 54	31	10	28	05	02 39 60	40 43 28	68
	Aurigæ	50 42 34	13	18	33	03	02 42 27	50 45 98	71
	Leporis	5 01 21 22	40	06	30	01	02 21 35	5 01 25 08	73
E	ι Orionis	09 52 19	31	09	28	01	02 52 86	09 56 64	78
	Bellatrix	19 55 74	25	12	28	03	02 56 40	20 00 12	72
	B.A.C.1740	27 28 41	53	02	41	04	02 29 38	27 32 90	52
	κ Orionis	43 09 07	30	08	28	07	02 09 78	43 13 42	64
	ι Orionis	49 55 24	25	12	28	09	02 55 96	49 59 67	71

σ = ·147 σ = ·280

Chronometer correction at 5h 06m 3s·684 ± ·031

TRANSIT OBSERVATIONS.

Station: WELLINGTON. Date, December 17th, 1903. Observer: THOS. KING.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	v.
		h. m. s.	s.	s.	s.	s. r 04	s.		h. m. s.	s.	s.
E	ξ^1 Ceti	2 07 51 17	·19	·31	·26	·03	02 51 88		2 07 55 41	3 53	·03
	ϕ Eridani	13 00 97	·47	·12	·41	·03	02 01 68		13 05 33	·65	·09
	ζ Ceti	22 59 94	·19	·31	·26	·02	02 60·66		23 04 66	·40	·16
	ν Ceti	30 46 69	·20	·29	·25	·01	02 47 40		30 50·95	·55	·01
	γ^2 Ceti	38 16 07	·21	·28	·25	·01	02 16 78		38 20 39	·61	·05
W	σ Arietis	46 08 57	·25	·34	·26	·00	02 08 88		46 12 47	·59	·03
	μ Horologii	3 01 18 57	·85	·26	·51	·01	03 18 63		3 01 22 15	·52	·04
	τ^1 Arietis	15 38 30	·21	·38	·27	·02	02 38·62		15 42 18	·56	·00
	o Tauri	19 35 99	·29	·31	·26	·02	02 36 33		19 39 82	·49	·07
	11 Tauri	34 59·49	·22	·40	·28	·03	02 59 84		35 03 51	·67	·11

a = ·399 c = ·254

Chronometer correction at $2^h\ 51^m$ 3·559 ± ·027

Station: WELLINGTON. Date, December 18th, 1903. Observer: THOS. KING.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	v.
		h. m. s.	s.	s.	s.	s. r 04	s.		h. m. s.	s.	s.
E	ξ^1 Ceti	2 07 50 27	·21	·32	·24	·02	02 51 00		2 07 55 41	4 41	·07
	ϕ Eridani	13 00 03	·51	·13	·39	·02	02 00 76		13 05 31	·55	·07
	ξ^2 Ceti	22 58·89	·21	·32	·24	·01	02 59 63		23 04 06	·43	·05
	δ Ceti	34 29 32	·24	·28	·24	·01	02 30 05		34 34 50	·45	·03
	γ^2 Ceti	38 15·14	·23	·29	·24	·00	02 15 88		38 20 39	·51	·03
W	γ Arietis	46 07 73	·21	·36	·25	·00	02 08 03		46 12 47	·44	·04
	ϵ Arietis	53 39 64	·18	·39	·26	·01	02 39 94		53 44 39	·45	·03
	α Horologii	3 01 17 79	·69	·27	·48	·01	03 17 71		3 01 22 13	·42	·06
	τ^1 Arietis	15 37 40	·17	·40	·26	·02	02 37 71		15 42 18	·47	·01
	o Tauri	19 34 81	·23	·32	·24	·03	02 35 13		19 39 82	·69	·21

a = ·420 c = ·239

Chronometer correction at $2^h\ 43^m$ 4·479 ·029

W	α Reticuli	4 13 08 89	·76	·21	·73	·03	03 08 65		4 13 13 29	4 64	·05
	ϵ Tauri	22 57 33	·20	·25	·36	·02	02 57 38		23 01 93	·55	·14
	α Tauri	30 21 16	·21	·23	·35	·02	02 21 21		30 25 99	·78	·09
	τ Tauri	36 25 56	·18	·26	·36	·01	02 25 61		36 30 33	·72	·03
	μ Eridani	40 38 47	·29	·16	·34	·01	02 38 55		40 43 32	·77	·08
E	ϵ Aurigæ	50 40 66	·09	·31	·40	·00	02 41 44		50 46 04	·60	·09
	ϵ Leporis	5 01 19·67	·30	·10	·36	·01	02 20 42		5 01 25 12	·70	·01
	β Orionis	09 51 20	·25	·15	·34	·01	02 51 93		09 56 70	·77	·08
	γ Bellatrix	19 54 80	·20	·20	·34	·02	02 55 54		20 00 18	·64	·05
	β Doradus	32 14 56	·59	·21	·73	·03	03 45 67		32 50 36	·69	·00

a = ·268 c = ·336

Chronometer correction at $4^h\ 53^m$ 4·687 ·023

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station: WELLINGTON. Date, January 10th, 1904. Observer: Thos. King

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	v
		h. m. s.	s.	s.	s.	s. ·012	s.		h. m. s.	s.	s.
E	o¹ Eridani	4 06 29 16	·07	-·38	-·17	·01	·02	29·63	4 07 11 76	42·13	·04
	ζ Tauri	22 18·96	·05	-·61	-·18	·01	·02	19·69	23 01 92	42·23	·09
	α Doradûs	31 15 00	·15	·28	·30	·01	·03	14·85	31 56 83	41·98	·16
	π¹ Orionis	43 56·04	·06	·50	·17	·01	·02	56·64	44 38 95	42·31	·17
W	κ Orionis	5 42 31 39	·02	·35	·17	·00	·02	31·53	5 43 13 60	42·67	·07
	1 Geminorum	57 36·16	·01	·65	·19	·01	·02	36·58	58 18 65	42·07	·07
	α Argûs	6 21 09 83	·03	·22	·28	·01	·03	09·26	6 21 51 57	42·31	·17
	γ Geminorum	31 29·16	·01	-·59	·18	·01	·02	29·53	32 11 52	41·99	·15

a = ·665 c = ·173

Chronometer correction at 5h 18m 42s·135 ±·050

PERSONAL EQUATION

TRANSIT OBSERVATIONS.

Station: WELLINGTON. Date, January 11th, 1904. Observer: THOS KING.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	v.
		h. m. s.	s.	s.	s.	s. ·024	s.		h. m. s.	s.	s.
E	ε Geminorum	6 37 20·13	·02	·83	·14	·02	·02	21·12	6 38 03 20	42·08	·14
	ε Canis Majoris	54 10 46	·08	·20	·14	·01	·02	10·87	54 52 89	42·02	·08
	δ Geminorum	7 13 42 19	·05	·80	·13	·01	·02	43·16	7 14 24 99	41·83	·11
	Q Carinæ	32 37 73	·11	·25	·20	·00	·03	37·76	33 19 64	41·88	·06
W	ζ Argûs	59 32 86	-·20	-·02	·16	·01	·02	32·89	8 00 14 68	41·79	·15
	ε Argûs	8 19 54 36	-·29	·49	·24	·02	·03	53·87	20 35 89	42·02	·08

a = ·817 c = -·122

Chronometer correction at 7h 28m -41s·935 ±·044

TRANSIT OBSERVATIONS.

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station: WELLINGTON. Date, January 10th, 1904. Observer: OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	c.
			s.	s.	s.	s. r = ·012	s.		h. m. s.	s.	s.
E	η Tauri	3 41 05·34	·04	- ·68	- ·23	- ·01	·02	06·20	3 41 47·80	-41·60	·01
	γ¹ Eridani	52 51·95	·08	- ·32	+ ·22	- ·01	·02	52·40	53 33·95	·55	- ·04
	ω¹ Tauri	4 02 53·18	·05	- ·63	- ·23	+ ·01	·02	53·98	4 03 35·55	·57	- ·02
	α Reticuli	12 31·44	·18	·55	- ·46	- ·01	·03	31·15	13 12·73	·58	- ·01
	τ Tauri	35 47·83	·04	- ·67	- ·23	·00	- ·02	48·67	36 30·33	·66	- ·07
W	α Ursæ Minoris	5 00 43·65	- ·06	- ·25	·23	·00	- ·02	43·59	5 01 25·11	·52	- ·07
	[illegible]is	19 18·63	·04	- ·38	·22	·00	- ·02	18·73	20 00·27	·54	+ ·05
	[illegible]adûs	32 09·65	·12	- ·54	·46	·01	- ·03	08·49	32 50·12	·63	- ·04
	[illegible]onis	49 18·02	- ·04	- ·52	·22	·01	- ·02	18·25	49 59·91	·66	- ·07
	[illegible]eminorum	6 08 24·61	·03	- ·67	·23	·01	·02	24·99	6 09 06·55	·56	+ ·03

$a = -$ ·689 $c = +$ ·213

Chronometer correction at $4^h\ 54^m = -41^s\ 586 \pm$ ·014

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station: WELLINGTON. Date, January 11th, 1904. Observer: OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	c.
		h. m. s.	s.	s.	s.	s. r = ·012	s.		h. m. s.	s.	s.
E	γ Geminorum	6 31 29·21	- ·03	- ·66	- ·10	- ·01	·02	29·99	6 32 11·52	-41·53	·01
	α Pictoris	46 34·34	- ·10	·56	- ·20	·00	·03	34·05	47 15·57	·52	·00
	δ Canis Majoris	7 03 49·06	- ·05	- ·22	- ·10	·00	·02	49·41	7 04 30·96	·55	·03
	ϑ Canis Minoris	21 16·04	- ·03	- ·58	- ·09	·00	·02	16·72	21 58·21	·49	- ·03
W	ξ Argûs	44 35·25	- ·22	- ·24	- ·10	·00	·02	35·59	45 17·11	·52	·00
	γ Argûs	8 05 55·34	+ ·31	·11	- ·14	- ·01	·02	55·37	8 06 36·89	·52	·00

$a = -$ ·754 $c = +$ ·093

Chronometer correction at $7^h\ 15^m = -41^s\ 521 \pm$ ·008

Hence the weighted mean, King anticipates Klotz ·257 ± ·045

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station: OTTAWA. Date, June 22nd, 1904. Observer: F. W. O. WELBY.

Chang.	Star.	Transit over mean of threads	Level and inequality of pivots	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
E	201	15 15 24 42	·06	·03	·55	·07	·02	23 89	15 11 39 88	3 44 01	·02
	203	24 40 21	·05	·18	1 50	·06	·05	38 49	20 54 52	43 97	·02
	205	27 38 81	·01	·04	·53	·04	·02	38 33	23 54 26	44 07	·08
	206	31 15 42	·01	·01	·61	·03	·02	14 84	27 30 80	44 04	·05
	593	33 56 21	·01	·11	·47	·03	·02	55 87	30 11 87	44 00	·01
	212	43 18 88	·04	·08	·46	·00	·01	18 53	39 34 62	43 91	·08
W	217	51 12 67	·07	·38	2 23	·01	·07	15 13	47 31 16	43 97	·02
	221	16 09 30 30	·04	·00	·65	·06	·02	30 91	16 05 46 90	44 01	·02
	222	13 05 02	·02	·11	·46	·07	·01	05 31	09 21 35	43 96	·03
	223	17 00 56	·03	·11	·46	·07	·01	00 86	13 16 98	43 88	·11
	225	21 27 09	·05	·07	·49	·08	·02	27 46	17 43 39	44 07	·08
	473	24 45 19	·05	·08	·47	·09	·02	45 52	21 01 47	44·05	·06

a_1 = ·121 a_2 = ·146 c = ·460

Chronometer correction at $15^h\ 45^m$ = $3^m\ 43^s\cdot993 \pm \cdot014$

W	229	16 31 55 52	·15	·02	1 07	·07	·01	56 75	16 28 52 76	3 43 99	·10
	230	34 46 33	·08	·00	·52	·06	·02	46 97	31 02 78	44 19	·10
	231	41 25 98	·07	·00	·45	·04	·02	26 52	37 42 44	44 08	·01
	232	43 22 17	·08	·00	·50	·04	·02	22 77	39 38 59	44 18	·09
	478	51 28 [illegible]	·05	·01	·40	·02	·02	29 06	47 45 00	44 06	·03
	233	56 53 4[illegible]	·05	·01	·39	·01	·01	53 89	53 09 87	44 02	·07
E	234	17 00 23 71	·15	·00	·45	·00	·02	23 39	56 39 36	44 03	·06
	598	08 39 67	·07	·01	·40	·02	·02	39 31	17 04 55 12	44 19	·10
	236	12 18 13	·31	·01	·94	·03	·01	17 42	08 33 37	44 05	·04
	238	14 52 23	·14	·00	·42	·03	·02	51 90	11 07 73	44 17	·08
	241	34 15 59	·12	·01	·39	·08	·02	15 23	30 31 18	44 05	·04

a = ·015 c = ·384

Chronometer correction at $17^h\ 00^m$ $3^m\ 44^s\cdot095 \pm \cdot016$

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station : OTTAWA. Date, June 22nd, 1904. Observer : OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads	Level and inequality of pivots.	Azimuth	Collimation.	Rate.	Aberration.	Seconds of cont. transit.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	r = s. ·14	s.		h. m. s.	m. s.	s.
E	201	15 15 23·01	·00	- ·16	- ·42	- ·07	·02	23·64	15 11 39·88	3 43·76	·09
	203	24 38·22	·08	1·01	- 1·15	+ ·06	·05	38·45	20 54·52	·93	- ·08
	205	27 37·37	·04	- ·22	- ·40	+ ·04	·02	38·05	23 54·26	·79	·06
	206	31 13·94	- ·05	- ·07	- ·47	+ ·03	·02	14·54	27 30·80	·74	·11
	503	33 54·74	- ·03	- ·61	- ·36	+ ·03	·02	55·75	30 11·87	·88	·03
	212	43 17·73	- ·04	- ·43	- ·36	·00	·01	18·55	39 34·62	·93	- ·08
W	217	51 19·60	·99	1·79	1·71	- ·01	·07	15·03	47 31·16	·87	- ·02
	221	16 09 31·58	·35	- ·01	·50	- ·06	·02	30·66	16 05 46·90	·76	- ·09
	222	13 05·37	·16	- ·51	- ·35	·07	·01	05·29	09 21·35	·94	- ·09
	223	17 00·95	·16	- ·53	·35	·07	·01	00·89	13 16·98	·91	+ ·06
	225	21 27·68	·23	- ·32	·37	- ·08	·02	27·30	17 43·39	·91	+ ·06
	473	24 45·63	·21	- ·36	- ·36	- ·09	·02	45·31	20 01·47	·84	·01

a = + ·685 c = + ·352

Chronometer correction at 15h 45m = 3m 43s·855 ± ·016

W	229	16 31 59·09	·53	- ·67	·99	+ ·07	·04	56·93	16 28 12·76	-3 44·17	- ·14
	230	34 47·44	·32	- ·04	·48	+ ·06	- ·02	46·72	31 02·78	43·94	·09
	231	41 26·80	·27	+ ·17	- ·41	+ ·04	- ·02	26·31	37 42·44	43·87	·16
	232	43 23·23	·30	- ·08	- ·46	+ ·04	- ·02	22·57	39 38·59	43·98	·05
	478	51 29·28	·	- ·32	·37	+ ·02	·00	29·04	47 45·00	44·04	- ·01
	233	56 54·		·36	·36	- ·01	- ·01	53·93	53 09·87	44·06	+ ·03
E	234	17 00 22·72	- ·08	- ·	+ ·41	·00	·02	23·37	56 39·36	44·01	·02
	598	08 38·33	- ·04	- ·55	+ ·37	- ·02	- ·02	39·25	17 04 55·12	44·13	- ·10
	236	12 16·95	- ·16	·52	+ ·87	·03	·04	17·39	08 33·37	44·02	·01
	238	14 51·07	- ·07	- ·24	+ ·39	- ·03	- ·02	51·72	11 07·73	43·99	- ·04
	241	34 14·58	- ·06	- ·34	+ ·36	- ·08	·02	15·24	30 31·18	44·06	- ·03
	600	35 51·41	- ·04	- ·55	+ ·37	- ·08	·02	52·27	32 08·19	44·08	- ·05

a = ·607 c = ·354

Chronometer correction at 17h 00m = 3m 44s·033 ± ·017

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station : OTTAWA. Date, June 23rd, 1904. Observer: F. W. O. WERRY.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	P.
		h. m. s.	s.	s.	s.	s. r= ·14	s.		h. m. s.	m. s.	s.
E	182	13 3 55·41	·06	+ ·10	- ·10	- ·07	·02	55·40	13 50 08·45	3 46·95	·03
	183	14 00 34·36	·06	- ·15	·09	·06	·01	34·41	56 47·49	46·92	·06
	184	05 35·98	·09	·17	·21	·04	·01	35·51	14 01 48·40	47·11	·13
	458	09 49·88	·03	- ·08	- ·10	- ·04	·02	49·85	06 02·91	46·94	·04
	185	11 35·40	- ·02	+ ·19	- ·09	- ·03	·02	35·49	07 48·52	46·97	·01
	186	14 47·63	- ·03	- ·17	·09	+ ·02	·01	47·69	11 00·80	46·89	·09
	188	16 32·66	·01	·01	- ·13	- ·02	·02	32·51	12 45·53	46·98	·00
W	191	27 04 14	- ·02	- ·16	+ ·09	·00	·01	04·40	23 17·40	47·00	- ·02
	192	31 30 19	+ ·02	- ·07	- ·10	·02	·02	30·34	27 [illegible]·27	47·07	·09
	194	40 01 55	·03	·11	·09	·03	·02	01·73	36 14·78	46·95	·03
	196	41 48·98	·02	·17	·09	·04	·01	49·21	38 02·18	47·03	·05
	197	45 12·65	·02	·15	+ ·09	- ·05	·02	12·84	41 25·77	47·07	- ·09
	198	54 47·21	- ·10	- ·41	- ·34	- ·07	·06	47·11	51 00·20	46·91	·07

a = + ·223 c = ·09

Chronometer correction at 14h 25m 3m 46s·983 - ·014

W	465	15 04 08·92	- ·06	- ·01	- ·10	·07	·02	09·12	15 00 21·83	3 47·29	- ·08
	201	15 26·91	- ·08	·01	- ·11	·04	·02	27·11	11 39·87	24	- ·03
	203	24 41·10	- ·22	- ·05	+ ·30	+ ·02	·05	41·64	20 54·47	·17	- ·04
	205	27 41·31	- ·08	·01	- ·11	- ·02	·02	41·49	23 54·25	·24	- ·03
	206	31 17·88	- ·12	·00	+ ·11	- ·01	- ·02	18·10	27 30·80	·30	- ·09
E	212	43 21·80	+ ·11	·02	- ·09	·01	·01	21·78	39 34·61	·17	·04
	213	45 34·84	- ·13	·01	·10	·03	·02	34·81	41 47·60	·21	·00
	215	48 14·47	- ·13	·01	·10	·03	·02	14·44	44 27·29	·15	·06
	217	51 18·23	- ·57	- ·08	- ·45	·04	·07	18·32	47 31·10	·22	- ·01
	221	16 09 34·10	- ·21	·00	·13	·08	·02	34·08	16 05 46·89	·19	·02
	222	13 08·58	·10	·02	·09	·08	·01	08·48	09 21·34	·14	·07

a = ·030 c = ·093

Chronometer correction at 15h 30m 3m 47·215 - ·012

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station : OTTAWA. Date, June 23rd, 1904. Observer : OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
						r ·14					
E	183	14 00 33·77	-·04	-·52	+·03	-·06	·01	34·41	13 56 47 49	3 46 92	05
	184	05 35 71	-·11	·59	+·07	-·04	·04	35 30	14 01 48 40	90	03
	458	09 49 35	-·06	-·29	+·03	-·04	-·02	49 75	06 02 91	84	03
	185	11 34 71	+·03	-·63	+·03	-·03	·02	35 41	07 48 52	89	02
	186	14 47·07	·04	+·59	+·03	-·02	·01	47 74	11 00 80	24	07
	188	16 32·21	-·10	·02	-·04	+·02	·02	32 33	12 45 53	80	·07
W	191	27 03·85	·12	-·55	·03	00	·01	04 24	23 17 10	84	03
	192	31 30·20	·22	-·23	·03	-·01	·02	30 15	27 43 27	88	-·01
	194	40 01·39	16	-·38	·03	·03	·02	01·53	36 14 78	·75	12
	196	41 48 72	11	+·59	03	04	·01	49 12	38 02 18	94	-·07
	197	45 12 38	13	-·51	03	·05	·02	12·66	41 25 77	·89	-·02
	198	54 49 27	57	1·37	·11	·07	·06	47 09	51 00 20	89	-·02

$a = +^s·755$ $c = -^s·027$

Chronometer correction at $14^h\ 25^m = -3^m\ 46^s·872 \pm ^s·013$

W	199	15 02 08 65	-·23	-·09	-·02	-·07	·02	08·58	14 58 21 56	3 47·02	05
	465	04 08·70	-·18	+·29	+·02	-·07	·02	08·88	15 00 21·83	·05	02
	201	15 26·88	·20	+·20	+·02	+·04	02	26·92	11 39·87	05	·02
	203	24 43 30	-·51	-1·23	+·05	+·02	-·05	41·58	20 54·47	11	-·04
	205	27 41 20	-·19	+·27	+·02	-·02	02	41·30	23 54 25	05	02
	206	31 17·98	-.23	-·08	+·02	+·01	02	17·84	27 30 80	·04	03
E	212	43 21 14	-·11	+·52	-·02	-·01	·01	21·73	39 34 61	12	05
	213	45 24 20	-·12	-·42	-·02	-·03	-·02	34·67	41 47 60	07	03
	215	48 13 87	13	+·40	-·02	-·03	-·02	14·33	44 27·29	04	·03
	217	51 19 96	55	2·18	-·08	-·04	-·07	18·14	47 31 10	04	·00
	222	16 13 07 91	-·09	-·62	-·02	-·08	·01	08·51	16 09 21 34	17	-·10

$a = +^s·834$ $c = -^s·016$

Chronometer correction at $15^h\ 30^m = -3^m\ 47^s·073 \pm ^s·010$

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station: OTTAWA. Date, June 24th, 1904. Observer: F. W. O'REILLY

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of one transit.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
E.	182	13 53 58·65	·08	·07	·09	·07	·02	58·60	13 50 08·44	3 50 16	10
	183.	14 00 37 69	05	·10	·09	06	·01	37·70	56 47 48	22	04
	184.	05 39 18	·12	·11	21	05	04	38·75	14 01 48·36	39	·13
	458.	09 53 22	·02	·06	10	04	·02	53·18	06 02 90	28	·02
	185.	11 38 66	02	·12	09	03	·02	38·68	07 48 51	17	09
	186.	14 51 00	01	11	09	·02	·01	51·02	11 00 80	22	04
W	192.	31 33·55	08	04	10	01	·02	33·58	27 13 26	32	·06
	194.	40 04 91	06	·07	09	03	·02	04·96	36 14 78	·18	08
	196.	41 52 38	·03	·11	09	·04	·01	52·50	38 02 17	·33	·07
	197.	45 15 97	·03	·10	09	05	·02	16·06	41 25 76	30	·04
	590.	49 26 65	·02	·13	·09	06	·02	26·77	45 36 38	·39	13
	198.	54 50 50	09	·27	34	07	·06	50·35	51 00 14	·21	05

$a = +\cdot146$ $c = \cdot088$

Chronometer correction at $14^h\ 25^m$ $3^m\ 50^s\cdot266 \pm \cdot016$

W	465.	15 04 12 25	·02	·06	·11	09	·02	12·47	15 00 21 82	3 50 65	06
	201	15 50 25	01	·04	10	07	·02	30·43	11 39 86	57	02
	467.	17 24 26	·00	·18	23	06	·04	24·33	13 33 81	52	07
	202.	24 44 19	00	·03	·11	04	·02	44·35	20 53 73	62	·03
	205.	27 44 58	00	·06	10	04	·02	44·76	23 54 24	·52	02
	206.	31 21 36	·00	·02	11	03	·02	21·50	27 30 79	71	·17
E	212.	43 25 15	07	·12	09	00	01	25·24	39 34 61	63	04
	213.	45 38 15	08	·09	09	00	·02	38·21	41 47 60	61	02
	215.	48 17 85	08	·09	09	01	·02	17·90	44 27 28	62	·03
	217.	51 22 22	·37	·48	·42	02	·07	21·60	47 31 03	57	02
	597.	16 35 15	·06	·15	09	12	·02	45·44	16 31 54 98	46	13
	232.	43 29 [illegible]	·15	·03	11	14	·02	29·18	39 38·58	60	·01

$a = +\cdot184$ $c = \cdot087$

Chronometer correction at $15^h\ 40^m$ $3^m\ 50^s\cdot589 \pm \cdot015$

PERSONAL EQUATION.

TRANSIT OBSERVATIONS.

Station : OTTAWA. Date, June 24th, 1904. Observer: OTTO KLOTZ.

Clamp.	Star.	Transit over mean of threads.	Level and inequality of pivots.	Azimuth.	Collimation.	Rate.	Aberration.	Seconds of corr. transit.	R. A.	Chronometer correction.	
		h. m. s.	s.	s.	s.	s.	s.		h. m. s.	m. s.	s.
E	182	13 53 58·05	-·16	·39	·06	-·07	·02	58·59	13 50 08·44	3 50·15	·05
	183	14 00 37·02	-·13	·57	·06	·06	·01	37·71	56 47·48	·23	·02
	184.	05 38·91	·44	·65	·13	·05	·04	38·58	14 01 48·36	·22	·01
	458.	09 52·58	·22	·32	·06	·04	·02	53·08	06 02·90	·18	·03
	185.	11 37·99	·12	·69	·06	-·03	·02	38·75	07 48·51	·24	·03
	186.	14 50·28	·14	·65	·06	-·02	·01	51·02	11 00·80	·22	·01
W	192.	31 33·29	·16	·25	-·07	·01	-·02	33·42	27 43·26	·16	·05
	194.	40 04·59	·13	·42	·06	·03	·02	04·89	36 14·78	·11	·10
	196.	41 51·87	·09	-·65	-·06	·04	-·01	52·44	38 02·17	·27	·06
	197.	45 15·55	·11	-·57	·06	·05	·02	16·00	41 25·76	·24	·03
	198.	54 52·26	·47	1·51	·21	·07	-·06	50·36	51 00·14	·22	·01
	199.	15 02 11·92	-·19	·09	·07	·08	·02	11·79	58 21·55	·24	·03

a = -·831 c = ·057

Chronometer correction at $14^h\ 25^m$ $3^m\ 50^s\cdot206 \pm \cdot011$

W	465.	15 04 11·94	-·10	-·30	-·03	-·09	-·02	12·24	15 00 21·82	3 50·42	·00
	201.	15 30 12·11	·21	-·04	-·07	-·02	·30·31	11 39·86	·45	-·03	
	467.	17 25·28	-·24	·86	-·08	-·06	-·04	24·28	13 33·81	·47	-·05
	202.	24 44·02	·12	-·15	·04	-·04	·02	44·11	20 53·73	·38	·04
	205.	27 44·40	-·11	-·27	-·03	-·04	-·02	44·61	23 54·24	·37	·05
	206.	31 21·19	-·13	·09	-·04	-·03	-·02	21·20	27 30·79	·41	·01
E	212.	43 24·42	+·18	-·54	·03	·00	·01	25·10	39 34·61	·49	·07
	213.	45 37·46	+·21	-·44	·03	·00	-·02	38·06	41 47·60	·46	·04
	215.	48 17·20	+·21	-·41	·03	·01	·02	17·76	44 27·28	·48	-·06
	217.	51 23·00	+·93	2·25	·15	·02	-·07	21·44	47 31·03	·41	·01
	597.	16 35 44·70	+·13	-·72	·03	·12	·02	45·38	16 31 54·98	·40	·02
	232.	43 28·68	+·29	·12	·04	·14	-·02	28·89	39 38·58	·31	·11

a = -·858 c = ·030

Chronometer correction at $15^h\ 40^m$ $3^m\ 50^s\cdot426 \pm \cdot012$

PERSONAL EQUATION.

KLOTZ WERRY.

Date. 1904.	Clock Correction. Klotz. m. s.	s.	Werry m. s.	s.	K W s.
June 22	3 43·855	016	3 43·994	014	138
" 22	44·033	017	44·095	016	062
" 23	46·872	013	46·983	014	111
" 23	47·073	010	47·210	012	137
" 24	50·206	011	50·266	016	060
" 24	50·426	012	50·589	015	163

	s.	s.
Weighted mean	116	± 011
Klotz transit west of Werry's	068	
Klotz anticipates Werry	124	± 011

DIFFERENCE OF LONGITUDE.

From the preceding observations and their clock corrections combined with the times of exchange, we obtain the following differences of longitude between the successive stations, and subsequent final values.

The Canadian longitude values are based on the longitude of

Montreal . . . . . $4^{h.}\ 54^{m.}\ 18{\cdot}634^{sec.} \pm {\cdot}049^{sec.}$

Ottawa was connected in 1896 with Montreal, the observers, Dr. King and Prof. McLeod, exchanging stations and the value obtained

Ottawa . . . . . $5^{h.}\ 02^{m.}\ 50{\cdot}022^{sec.} \pm {\cdot}049^{sec.}$

In 1900 Vancouver was connected by a direct circuit of 3,000 miles with Ottawa. The observers, Dr. King and Dr. Klotz, exchanging stations also.

Vancouver . . . . . $8^{h.}\ 12^{m.}\ 28{\cdot}36^{sec.} \pm {\cdot}050^{sec.}$

This last value is the initial one for the Transpacific longitudes.

DIFFERENCE OF LONGITUDE.

VANCOUVER - FANNING.

Date.	Direction.	Sidereal Time. Bamfield.	Sidereal Time. Vancouver.	Difference.	Relative rate per hour.	Transmission time.	Chronometer Correction. Vancouver	Chronometer Correction. Fanning.	Difference from Bamfield Chronometer
1903.		h. m.	h. m.	h. m. s.	s.	s.	s.	m' s.	h. m. s.
April 15	B. to V.	12 13·98	12 11 80	0 02 10 585					
	V. to B.	12 15 59	12 13 41	10 672	....	039			
	Mean	12 14 79	12 12 61	0 02 10 629					
	B. to V.	12 48·70	12 46 50	0 02 10 771					
	V. to B.	12 49 90	12 47 70	10 891	.....	056			
	Mean	12 49 30	12 47 10	0 02 10 831					
	General Mean	12 32 05	12 29 85	0 02 10 730	·351				
		12 28 55	.....	0 02 10·710	. .. . . .		47 253	.. ..	0 02 57 963
		Bamfield.	Fanning						
	B. to F.	12 27 40	9 58 10	2 29 19 673					
	F. to B.	12 29 70	10 00·40	19 771	·410	·341			
	Mean	12 28·55	9 59 25	2 29 19 422	.. . . . .		.....	1 15·780	2 28 03 642

h. m. s.

Difference of longitude, Vancouver-Fanning..... .... +2 25 05 679

NOTE. As explained in the text, Bamfield was simply used as an exchange station and no observations were made there. The exchange Bamfield-Vancouver was over a land line, while Bamfield-Fanning was over the cable. The difference of the two exchanges Bamfield-Vancouver, made before and after the Fanning exchange, was reduced to the mean time of exchange with Fanning by applying the rates of the Bamfield and Vancouver chronometers, the latter was known from the observations, while the former was obtained from the differential rate, shown by the two exchanges, and the Vancouver rate.

Date.	Direction	Sidereal Time. Bamfield.	Sidereal Time. Vancouver.	Difference.	Relative rate per hour.	Transmission time.	Chronometer Correction. Vancouver.	Chronometer Correction. Fanning.	Difference from Bamfield Chronometer
1903.		h. m.	h. m.	h. m. s.	s.	s.	s.	s.	h. m. s.
April 16	B. to V.	12 12 78	12 10 46	0 02 19 029					
	V. to B.	12 14 50	12 12 30	19 132	.	047			
	Mean	12 13 64	12 11 38	0 02 19 081					
	B. to V.	12 50 50	12 48 20	0 02 19 211					
	V. to B.	12 51 94	12 49 62	19 310		046			
	Mean	12 51 22	12 48 91	0 02 19 261					
	General Mean	12 32 43	12 30 15	0 02 19 171	·286				
		12 42·33		0 02 19 218	.	.	45 624	...	0 03 04 842
		Bamfield.	Fanning.						
	B. to F.	12 41·25	10 11 79	2 29 29 688					
	F. to B.	12 43 40	10 13·90	30 372	·419	335			
	Mean	12 42·33	10 12 80	2 29 30 039	....	.	....	1 19 622	2 28 10·408

h. m. s.

Difference of longitude, Vancouver Fanning . . . . ·2 25 05·566

Date.	Direction.	Sidereal Time. Bamfield.	Sidereal Time. Vancouver.	Difference.	Relative rate per hour.	Transit-system time.	Chronometer Correction. Vancouver.	Chronometer Correction. Fanning.	Difference from Bamfield Chronometer.
1903		h. m. s.	h. m. s.	h. m. s.	s.	s.	s.	m. s.	h. m. s.
April 18	B. to V.	12 15 95	12 11 40	0 02 33 5,7					
	V. to B.	12 15 60	12 13 05	33 677		047			
	Mean	12 14 78	12 12 23	0 02 33 627					
	B. to V.	12 45 85	12 43 30	0 02 33 709					
	V. to B.	12 47 11	12 44 55	33 801		039			
	Mean	12 46 48	12 43 93	0 02 33 755					
	General Mean	12 30 63	12 28 08	0 02 33 691	241				
		12 36 55		0 02 33 714			43 349		0 03 17 063
		Bamfield.	Fanning.						
	B. to F.	12 35 40	10 04 80	2 30 48 373					
	F. to B.	12 37 60	10 06 80	49 046	434	329			
	Mean	12 36 55	10 05 80	2 30 48 710				2 26 102	2 28 22 608

Difference of longitude, Vancouver Fanning . . . . . h. m. s. 2 25 05 545

Date.	Direction.	Sidereal Time. Bamfield.	Sidereal Time. Vancouver.	Difference.	Relative rate per hour.	Transit-system time.	Chronometer Correction. Vancouver.	Chronometer Correction. Fanning.	Difference from Bamfield Chronometer.
1903.		h. m.	h. m.	h. m. s.	s.	s.	s.	s.	h. m. s.
April 23	B. to V.	12 28 90	12 25 70	0 03 11 912					
	V. to B.	12 30 30	12 27 10	12 027		07			
	Mean	12 29 60	12 26 40	0 03 11 970					
	B. to V.	12 50 30	12 47 10	0 03 12 025					
	V. to B.	12 51 80	12 48 60	12 127		048			
	Mean	12 51 05	12 47 85	0 03 12 076					
	General Mean	12 40 33	12 37 13	0 03 12 023	297				
		12 40 35		0 03 12 023			34 541		0 03 46 564
		Bamfield.	Fanning.						
	B. to F.	12 39 40	10 09 80	2 29 37 974					
	F. to B.	12 41 30	10 11 70	38 682	386	348			
	Mean	12 40 35	10 10 75	2 29 38 328				46 272	2 28 52 05

Difference of longitude, Vancouver Fanning h. m. s. 2 25 05 492

Date	Direction	Sidereal Time: Bamfield.	Sidereal Time: Vancouver.	Differences.	Relative rate per hour.	Transmission time.	Chronometer Corrections: Vancouver	Chronometer Corrections: Fanning	Difference from Bamfield Chronometer
		h. m. s.	h. m. s.	h. m. s.	s.	s.	s.	s.	h. m. s.
1903.									
April 26	F. to V.	13 05 97	13 02 42	0 03 33 040					
	V. to B.	13 07 30	03 74	33 737		045			
	Mean	13 06 64	13 03 08	0 03 33 089					
	B. to V.	13 29 50	13 25 94	0 03 33 157					
	V. to B.	13 30 00	27 34	33 278		032			
	Mean	13 30 20	13 26 64	0 03 33 193					
	General Mean	13 18 42	13 14 86	0 03 33 141	26				
		13 19 00		0 03 33 143			29 200		0 04 02 583
		Bamfield.	Fanning						
	B. to F.	13 18 00	10 47 90	2 30 06 793					
	F. to B.	13 20 00	10 49 90	07 519	.531	557			
	Mean	13 19 00	10 48 90	2 30 07 156				59 140	2 29 08 016

Difference of longitude, Vancouver Fanning 2 25 05 483

VANCOUVER FANNIS

		h. m. s.	s.
1903.			
April 15	Difference of longitude	2 25 05 679	± 019
16		5 566	± 016
18.		5 545	± 025
23.		5 492	± 010
26		5 483	± 015
	Weighted Mean	2 25 05 530	± 021
	Personal Equation	124	
	Difference of Longitude	2 25 05 406	± 021
	Vancouver	8 12 28 368	± 050
	Longitude of Fanning.	10 37 33 774	± 054

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FANNING—SUVA.

Date	Direction.	Suva Clock. Fanning.	Suva Clock. Suva.	Difference.	Equation.	Equation.	Chronometer Correction. Fanning.	Chronometer Correction. Suva.	Difference.
1903		h. m. s.	h. m. s.	h. m. s.	s.	s.	s.	h. m. s.	h. m. s.
June 2, 3	F. to S.	15 43 5	14 18 0	1 25 29 640					
	S. to F.	15 45 9	14 20 4	30 196	·007	281			
	Mean.	15 44 7	14 19 2	1 25 29 918			14 333	3 28 1	1 28 1 671
4, 5	F. to S.	15 49 9	14 24 5	1 25 24 605					
	S. to F.	15 51 8	14 26 4	25 134	·008	269			
	Mean.	15 50 85	14 25 45	1 25 24 870			12 328	3 31 132	43 6, 4
8, 9	F. to S.	15 56 6	14 31 6	1 25 02 034					
	S. to F.	15 58 7	14 33 7	02 585	·008	280			
	Mean.	15 57 65	14 32 65	1 25 02 310			3 601	3 4 1	43 713
9, 10	F. to S.	15 36 4	14 11 4	1 24 58 577					
	S. to F.	15 38 2	14 13 2	59 157	·006	293			
	Mean.	15 37 3	14 12 3	1 24 58 867			2 541	3 47 42	43 7 1
10, 11	F. to S.	16 05 5	14 40 6	1 24 54 401					
	S. to F.	16 07 5	14 42 6	54 962	·007	284			
	Mean.	16 06 5	14 41 6	1 24 54 682			0 926	3 49 954	43 710
15, 16	F. to S.	16 46 1	15 21 5	24 34 187					
	S. to F.	16 48 6	15 24 0	34 766	·004	[illegible]			
	Mean.	16 47 35	15 22 75	1 24 34 477			6 716	4 02 519	43 712
21, 22	F. to S.	16 47 1	15 22 9	1 24 12 284					
	S. to F.	16 48 9	15 24 7	12 812	·004	266			
	Mean.	16 48 0	15 23 8	1 24 12 548			14 836	4 16 375	43 7 9
23, 24	F. to S.	16 70 9	15 35·8	1 24 04 826					
	S. to F.	17 01 7	15 37·6	05 400	·006	290			
	Mean.	17 00 8	15 36 7	1 24 05 11			17 842	4 20 767	43 722

FANNING—SUVA.

1903.			
June 2, 3	Difference of longitude	1 28	43 671 ± 016
3, 4			43 674 ± 013
8, 9			43 743 ± 019
9, 10			43 731 ± 017
10, 11			43 710 ± 014
15, 16			43 712 ± 016
21, 22			43 759 ± 017
23, 24			43 722 ± 021
	Weighted mean	1 28	43 715 ± 008
	Personal equation		124
	Difference of longitude	1 28	43 837 ± 008
	Fanning	10 37	33 774 ± 054
	Longitude of Suva	12 06	17 611 ± 055
		11 [illegible]	42 389 ± 055
	or east		

SUVA—NORFOLK.

Date	Direction.	Sidereal Time. Suva.	Sidereal Time. Norfolk.	Difference.	Relative rate.	Transmission time.	Chronometer Correction. Suva.	Chronometer Correction. Norfolk	Difference of Longitude.
1903.		h. m.	h. m.	h. m. s.	s.	s.	s.	m. s.	m. s.
Aug. 14	N. to S.	19 15 7	18 34 2	0 41 28 261					
	S. to N.	19 17·5	18 36 0	27 994	·006	137			
	Mean.	19 16·6	18 35·1	41 28 128			26 307	59 614	42 01 435
" 17	N. to S.	19 09 0	18 27 8	41 09·356					
	S. to N.	19 11·0	18 29 9	9 060	·003	·149			
	Mean.	19 10 0	18 28 85	41 09 208			31 304	1 23 475	01·379
" 19	N. to S.	19 14 8	18 33·9	40 56 028					
	S. to N.	19 17·4	18 36 5	55·767	·011	·136			
	Mean.	19 16·1	18 35·2	40 55·898			34 307	1 39 750	01·341
" 22	N. to S.	19 38 7	18 58 1	40 38 245					
	S. to N.	19 40 7	19 00 1	37·978	·006	·137			
	Mean.	19 39 7	18 59 1	40 38·112			38·877	2 02 145	01 380
" 23	N. to S.	20 03·8	19 23 3	40 32 221					
	S. to N.	20 05·7	19 25 2	31 951	·008	·139			
	Mean.	20 04·75	19 24·25	40 32·086			40 377	2 09·653	01·362
" 27	N. to S.	20 14 5	19 34 4	40 03 871					
	S. to N.	20 16 5	19 36 4	03 581	·009	·149			
	Mean.	20 15·5	19 35 4	40 03 726			42 931	2 40 528	01·323

Suva—Norfolk.

1903.		h. m. s.	s.
Aug. 14.	Difference of longitude	0 42 01 435	± ·017
" 17.	"	01·379	± 018
" 19.	"	01·341	± 019
" 22.	"	01·380	014
" 23.	"	01 362	± 024
" 27.	"	01 323	± ·013
	Weighted mean	0 42 01 367	± ·011
	Personal equation	− 124	
	Difference of longitude	0 42 01·243	± 011
	Suva	11 53 42·389	± ·055
	Longitude of Norfolk	11 11 41·146	± ·055

NORFOLK—SOUTHPORT.

Date.	Direction.	Sidereal Time. Norfolk.	Sidereal Time. Southport	Difference.	Relative rate.	Transmission time.	Chronometer Correction. Norfolk.	Chronometer Correction. Southport	Difference of Longitude.
1903.		h. m.	h. m.	h. m. s.	s.	s.	m. s.	m. s.	m. s.
Oct. 1	N. to S	23 21·4	22 23 3	0 58 05 322					
	S. to N	23 23 8	22 25 7	05 506	·010	·097			
	Mean ...	23 22 6	22 24 5	58 05 414			27 353	23 174	58 01 235
" 3	N. to S	22 54 9	21 57 0	57 55 332					
	S. to N ..	22 56 5	21 58 6	55 524	·003	·098			
	Mean ...	22 55 7	21 57 8	57 55 428	.....	.....	42 317	48 083	01 194
" 11	N. to S ..	23 20 0	22 22·4	57 38 363					
	S. to N	23 21 6	22 23 95	38 567	·006	·105			
	Mean ..	23 20 8	22 23 18	57 38 465			1 54 659	2 17 430	01 236
" 12	N. to S ..	23 26 7	22 29·2	57 33 158					
	S. to N	23 28 12	22 30·56	33 362	·003	·104			
	Mean ..	23 27 41	22 29 88	57 33 260	..	.	2 01 112	2 29·084	01 232
" 16	N. to S	23 34 5	22 37 3	57 13 983					
	S. to N ..	23 35 9	22 38 7	14 165	·006	·094			
	Mean ..	23 35 2	22 38 0	57 14 074			2 27 886	3 15 089	01 277

Norfolk Southport.

1903.		h. m. s.	s.
Oct. 1	Difference of longitude	0 58 01 235	± ·018
" 3	"	194	± ·019
" 11	"	236	± ·013
" 12	"	232	± ·014
16	"	277	± ·013
	Weighted Mean	0 58 01 240	± ·008
	Personal Equation	124	
	Difference of Longitude.....	0 58 01 364	± ·008
	Norfolk	11 11 41 146	± ·056
	Longitude of Southport	10 13 39 782	± ·056

SOUTHPORT—SYDNEY.

Date.	Direction.	Sidereal Time. South port.	Sidereal Time. Sydney.	Difference.	Relative rate.	Transmission time.	Chronometer Correction. South port.	Chronometer Correction. Sydney.	Personal Equation. K R	Personal Equation. K L	Difference of Longitude.
1903.		h. m.	h. m.	h. m. s.	s.	s.	m. s.		s.	s.	m. s.
Sept. 29	Sy. to S.	22 49·4	22 40 6	0 08 50·208	·041	·142		Sydney Observatory applied its clock correction to time of exchange, and is included in column Difference.			
	S. to Sy.	22 44 0	22 35 2	49 883							
	Mean	22 46 7	22 37·9	8 50 046			0 485		...	018 8	50·513
Oct. 2	Sy. to S.	22 40 2	22 30 8	9 25 887	050	137					
	S. to Sy.	22 35·6	22 26 2	25 563							
	Mean	22 37 9	22 28·5	9 25 725	.	.	35·181		·067		50 611
" 3	Sy. to S.	22 52 42	22 42 76	9 39·158	042	146					
	S. to Sy.	22 47 85	22 38·20	38·824							
	Mean	22 50 14	22 40 48	9 38·991			48 506		·067	. .	50 552
" 6	Sy. to S	23 11 11	23 00 95	10 11 567	·061	126					
	S. to Sy.	23 03·00	22 52 80	11·254							
	Mean	23 07 06	22 56 87	10 11 410			1 20·948		..	018	50 444
" 7	Sy. to S	23 11 0	23 00 64	10 22 141	041	145					
	S. to Sy	23 05 6	22 55·24	21 811							
	Mean	23 08 3	22 57 94	10 21 976	.....	. .	1 31 543		·067	..	50·500
" 8	Sy. to S	23 22·15	23 11 60	10 33 821	·048	·141					
	S. to Sy.	23 16 88	23 06·32	33·492							
	Mean	23 19 52	23 08·96	10 33·657	.....	.. .	1 43·281		·067	...	50 443

Southport Sydney.

1903.		h. m. s.	s.
Sept. 29	Difference of longitude	0 08 50·513	± ·029
Oct. 2	"	·611	± ·024
" 3	"	·552	± ·015
" 6	"	·444	± ·016
" 7	"	·500	± ·013
" 8	"	·443	± ·013
	Weighted Mean	0 08 50 495	± ·016
	Southport	10 13 39 782	± ·056
	Longitude of Sydney	10 04 49·287	± ·058

SOUTHPORT—BRISBANE.

Date.	Direction.	Sidereal Time. South-port.	Sidereal Time. Brisbane.	Difference.	Relative rate.	Transmission time.	Chronometer Correction. South-port.	Chronometer Correction. Brisbane.	Difference of Longitude.
1903.		h. m.	h. m.	h. m. s.	s.	s.	m. s.	s.	m. s.
Sept. 29	S. to B.	21 57·63	21 55 33	0 02 18·607					
	B. to S.	22 02·10	21 59 80	18·609	-·031	neg.			
	Mean	21 59 87	21 57·57	2 18·608			·805	-45·726	1 33 688
Oct. 2	S. to B.	22 07·60	22 04·66	2 55 699					
	B. to S.	22 09 30	22 06·40	55·715	·017	·000			
	Mean	22 08·45	22 05·53	2 55·707			34·882	-47 207	33·6
3	S. to B.	22 08·30	22 05 15	3 09 733					
	B. to S.	22 10 33	22 07·15	9·763	-·016	·007			
	Mean	22 09 32	22 06 15	3 09·748			48·176	-47·963	33·609
6	S. to B.	22 20·40	22 16 70	3 44 796					
	B. to S.	22 25 78	22 22·03	44·829	035	·000			
	Mean	22 23·09	22 19·37	3 44·813			1 20 656	-50·637	33·520
7	S. to B.	22 33 86	22 29·92	3 56 396					
	B. to S.	22 36·60	22 32 70	56·431	·019	·008			
	Mean	22 35·23	22 31·31	3 56·414			1 31·328	-51·504	33·582

SOUTHPORT-BRISBANE.

1903.			
September 29	Difference of longitude	h. m. s.	s.
October 2	"	0 01 33 688	± 018
" 3	"	618	± 015
" 6	"	609	± 013
" 7	"	520	± 011
	Weighted Mean	582	± 013
	Personal Equation	0 01 33 585	± 018
	Difference of Longitude	153	± 044
	Southport	0 01 33 738	± 047
	Longitude of Brisbane	10 13 39 782	± 056
		10 12 06 044	± 073

NORFOLK—DOUBTLESS BAY.

Date.	Direction.	Sidereal Time. Doubtless Bay.	Sidereal Time. Norfolk.	Difference.	Relative rate.	Transmission time.	Chronometer Correction. Doubtless Bay.	Chronometer Correction. Norfolk.	Difference of Longitude.
1903.		h. m.	h. m.	h. m. s.	s.	s.	m. s.	m. s.	m. s.
Dec. 5	N. to D.B.	2 23 7	2 01 5	0 22 14 386					
	D.B. to N	2 25 4	2 03 2	14 255	·004	·067			
	Mean ...	2 24 55	2 02 35	22 14 321	.....	.	17 342	18 073	22 15 052
9	N. to D.B	2 34·9	2 12 3	22 37 132					
	D.B. to N	2 36 4	2 13 8	37 027	·005	·055			
	Mean	2 35·65	2 13 05	22 37 080		.....	1 06 460	44 527	15·147
10	N. to D.B.	2 35 1	2 12 4	22 42 160					
	D.B. to N	2 36 6	2 13 9	42 101	·004	·032			
	Mean ..	2 35·85	2 13 15	22 42 131	...		1 18 274	51 215	15 072
11	N. to D.B..	2 55 5	2 32 7	22 47 251					
	D.B. to N.	2 57 1	2 34 3	47·131	·005	·062			
	Mean	2 56 3	2 33 5	22 47 191	.. .	....	1 29 662	57 545	15 074
17	N. to D.B..	3 15 8	2 52 5	23 18·124					
	D.B. to N.	3 17 3	2 54 0	18 018	·002	·054			
	Mean ...	3 16 55	2 53 25	23 18 071	.		2 39 513	1 36 667	15 225
18	N. to D.B	3 12·4	2 49 0	23 21 872					
	D.B. to N	3 13 8	2 50·4	21 738	·003	·068			
	Mean .	3 13 1	2 49 7	23 21·805	.		2 50 020	1 43 443	15·228

Norfolk Doubtless Bay.

1903.		h. m. s.	s.
December 5	Difference of longitude	0 22 15 052	± ·020
" 9	"	147	± ·020
" 10.	"	072	± ·014
" 11	"	074	± 015
" 17	"	·225	± ·020
" 18.	"	·228	± 017
	Weighted Mean	0 22 15 124	± ·021
	Personal Equation....	·124	
	Difference of Longitude.. ..	0 22 15 000	± 021
	Norfolk	11 11 41 146	± ·056
	Longitude of Doubtless Bay	11 33 56 146	± ·060

DOUBTLESS BAY—WELLINGTON.

Date.	Direction.	Sidereal Time. Wellington.	Sidereal Time. Doubtless Bay.	Difference.	Relative rate.	Transmission time.	Chronometer Correction. Wellington.	Chronometer Correction. Doubtless Bay.	Difference of Longitude.
1903.		h. m.	h. m.	h. m. s.	s.	s.	s.	m. s.	m. s.
Dec.	6 W. to D.B.	3 20·67	3 15·96	0 04 42·655	·347	·019			
	D.B. to W.	2 44·47	2 39·74	43·039					
	Mean	3 02·57	2 57·85	4 42·847			5·189	31·573	5 09·231
"	7 W. to D.B.	3 27·24	3 22·77	4 28·059	·096	·018			
	D.B. to W.	3 16·17	3 11·70	28·191					
	Mean	3 21·70	3 17·23	4 28·125			−3·180	44·255	09·200
"	11 W. to D.B.	3 31·66	3 28·02	3 38·167	·076	·026			
	D.B. to W.	3 23·39	3 19·76	38·296					
	Mean	3 27·53	3 23·89	3 38·232			−1·119	1 29·874	09·225
"	12 W. to D.B.	3 41·72	3 38·32	3 24·142					
	D.B. to W.	4 01·58	3 58·18	24·018	·171	·024			
	Mean	3 51·65	3 48·25	3 24·080			−3·530	1 41·546	09·156
"	17 W. to D.B.	4 05·70	4 03·27	2 25·729	·144	·041			
	D.B. to W.	4 26·16	4 23·73	25·659					
	Mean	4 15·93	4 13·50	2 25·690			−3·702	2 39·818	09·210
"	18 W. to D.B.	3 52·85	3 50·61	2 14·365	·083	·010			
	D.B. to W.	3 42·20	3 39·95	14·428					
	Mean	3 47·53	3 45·28	2 14·397			+4·582	2 50·220	09·199

Doubtless Bay—Wellington.

		h. m. s.	s.
Dec. 6	Difference of longitude	0 05 09·231	± ·027
" 7	"	200	± ·018
" 11	"	225	± ·032
" 12	"	156	± ·021
" 17	"	210	± ·032
" 18	"	199	·020
	Weighted mean	0 05 09·198	± ·007
	Personal equation	257	± ·045
	Difference of longitude	0 05 08·941	± ·045
	Doubtless Bay	11 33 56·146	± ·060
	Wellington	11 39 05·087	± ·075

CLOSING ERRORS.

Fanning. Reducing the longitude given on Admiralty Chart 2971, for 'Observation Spot' at English Harbour, by scaling to that of the observatory we obtain for the latter:

	159°	23′	27″
The Canadian value is.	159	23′	26″·61

that is, the values are practically identical, which speaks volumes for the accuracy of the hydrographic survey, which is principally dependent upon the transport of chronometers for the determination of longitude.

Captain Fanning writes, p. 225, in the work cited, 'These islands are situate in latitude 3° 51′ 30″ north, longitude 159° 12′ 30″ west.' The description is rather vague, but the position in longitude by a trading vessel, as Fanning's was, is pretty good for the year 1798.

Suva.—On Admiralty Chart 1660 of Suva Harbour, the longitude of 'Observation Spot,' south end of Walou bridge, is given as 178° 26′ 00″ E.; the observatory at the Cable station is 14″·21 west thereof, so that the longitude of the latter, based on the former becomes:

	178°	25′	45″·79	E.
The Canadian value is	178°	25′	35″·84	
Difference. . .			9″·95	= ·663^{sec} or 960 feet = 320 yards.

It may be interesting here to quote a paragraph of the opening address by the late Rear-Admiral, Sir W. J. L. Wharton, president of Section E., Geography, at the British Association meeting in South Africa last August. After speaking of the great merit of the sextant and chronometer for the determination of longitude at sea, he says: 'To give an idea of the comparative accuracy of the chronometer (transport of) method, I may mention that in taking at hazard eleven places distributed all over the world at great distances from England, the longitudes of which have been recently determined by means of the electric telegraph and elaborate series of observations, I find that the average difference between the chronometer and the telegraphic positions is 700 yards.'—So that the accordance at Suva is quite satisfactory.

Norfolk.—On Admiralty Chart 1110, 'Norfolk and Philip Islands' the longitude of 'Observation Spot' at the foot of Boat Harbour, Sydney Bay, is given as 167° 58′ 06″. Reducing this to the position, by scaling from the chart of the observatory at the Cable station, Anson Bay, at the northwestern part of the island we obtain for the longitude of the observatory:

	167°	55′	47″
The Canadian value is.	167°	55′	17″·19
Difference.			29″·81 = 1·99^{sec}

This is undoubtedly a large difference. The Admiralty determination is an old one, having been made by Captain Denham, R.N., in 1855, and measured through Lord Howe island from Garden island, Sydney, the latter being then not well determined.

Southport.—Southport, Queensland, is undoubtedly of the three Australian longitudes obtained by the Canadian connection, the best determined. In the first place the other two Australian stations—Sydney and Brisbane—are dependent upon it, and hence must necessarily have less weight, being an additional link in the chain; in the next place the personal equation is more thoroughly and satisfactorily eliminated for Southport than for the other two stations. As already stated the number of stations across the Pacific is an odd number—five—and as the observers occupied alternate stations from Vancouver to Southport, the personal equation even as an unknown quantity, which it is not, disappears in the value for Southport. And furthermore, the longitude work up to Southport (and Doubtless Bay also) was homogeneous in every respect, the instruments, apparatus, methods of the two observers were identical, so that the value for Southport deserves *a priori* a high degree of confidence.

There is however, no value for Southport, based by triangulation on the Brisbane longitude, available for comparison with the Canadian value. A comparison with Australian values we obtain, however, at Sydney and at Brisbane.

Sydney.—We have for Sydney, six independent determinations for difference of longitude with Southport, together with observations for personal equation between the observers, Mr. Lenehan and Mr. Raymond at Sydney, and Dr. Klotz at Southport.

In the following table is given the comparison between the longitude of Sydney as brought from Madras and Singapore and that *via* Canada and the British Pacific Cable.

In the reduction (1885) of the Australian longitudes, the longitude of Madras was accepted as:—

$5^{h.}\ 20^{m.}\ 59^{s}\ 42,$*

and the derived value of Sydney was:—

$10^{h.}\ 04^{m.}\ 49^{s}\cdot 54.$

In making the comparison, the best and most recent available data are utilized for the longitude of Madras. The values for the various links or arcs between Madras and Sydney have not been re-determined since 1882-84, so that they will be adopted now as then.

For arriving at the longitude of Madras, we have the following data:—

Arc.	Difference of Longitude.	Probable Error.	Authority.
	h. m. s.	s.	
Greenwich Potsdam	0 52 16 051	± 0030	Professor Albrecht [1]
Potsdam Tehran	2 33 24 228	± 0068	Major Burrard.[2]
Tehran Bushire	0 02 21 143	± 0083	
Bushire Karachi	1 04 44 787	± 0073	
Karachi Bombay	0 23 12 196	± 0129	
Bombay Bolarum	0 22 48 801	± 0061	
Bolarum Madras	0 06 54 615	± 0085	

Station.	Longitude East.	Probable Error.
	h. m. s.	s.
Potsdam	0 52 16 051	± 0030
Tehran	3 25 40 279	± 0074
Bushire	3 23 18 836	± 0111
Karachi	4 28 03 623	± 0133
Bombay	4 51 15 819	± 0185
Bolarum	5 14 04 620	± 0195
Madras	5 20 59 235	± 0213

* Report on the Telegraphic Determination of Australian longitudes, 1886, p. 51
[1] Bestimmung der Langendifferenz Potsdam-Greenwich, 1903.
[2] Great Trigonometrical Survey of India, Vol. XVII, p. XIV.

Applying now the published values for the arcs between Madras and Sydney, we obtain the following series:—

Arc.	Difference of Longitude.	†Probable Error.	Authority.
	h. m. s.	s.	
Madras	5 20 59 235	± 0213	
Madras - Singapore	1 34 25 58	± 0270	Davis and Norris (U. S. Navy).*
Singapore Flagstaff	0 00 01 50		
Flagstaff Capt. Darwin's Station	0 00 01 51		
Capt. Darwin's Station	6 55 24 825	± 0344	
Darwin's Station Port Darwin	1 47 57 48	± 0310	
Port Darwin	8 43 22 305	± 0463	
Port Darwin - Adelaide	0 30 57 81	± 0277	
Adelaide	9 14 20 115	± 0540	
Adelaide Melbourne	0 25 33 84	± 0337	
Melbourne	9 39 53 955	± 0636	
Melbourne Sydney	0 24 55 40	± 0614	
Sydney	10 04 49 355	± 0884	
Canadian value	10 04 49 287	± ·58	
**Difference	068		
	1″.02		
	84 feet.		

† The probable errors given for difference of longitude are taken from Appendix, Table I, p. 23 of P. Baracchi's report 'On the most Probable Value and Errors of Australian Longitudes,' 1895.

* Telegraphic Determination of Longitude in the East Indies, China and Japan, 1881-2.

** Since the above result was obtained, Astronomische Nachrichten, No. 3993, has appeared, containing 'Ausgleichung des Zentraleuropäischen Längennetzes' by Professor Th. Albrecht. The adjustment of the net involved 176 differences of longitude between 79 stations. In the final values Potsdam is given as $52^m\ 16^s{\cdot}06? \pm {\cdot}0135$ for the same meridian as given in the above table as $52^m\ 16^s{\cdot}051 \pm {\cdot}003$. That is, the adjusted longitude of Potsdam is greater than the direct measure of Prof. Albrecht and Mr. Wanach in 1903 by ·011. If we adopt the adjusted value for Potsdam, the longitude of Madras will be increased by ·011, that is, becomes $5^h\ 20^m\ 59^s{\cdot}246$, and similarly that of Sydney, $10^h\ 04^m\ 49^s{\cdot}366$. Differing from the Canadian value by ·079.

In the above-mentioned Astron. Nach. pp. 153-154, are given the results of the 1902 campaign for the arc Greenwich-Paris. The two Greenwich observers (with exchange of stations for eliminating personal equation) obtained the value of $9^m\ 20{\cdot}976^{sec} \pm {\cdot}011^{sec}$ in the spring, and in the autumn $9^m\ 20{\cdot}911^{sec} \pm {\cdot}004^{sec}$, giving a difference of $\cdot065^{sec}$ between the two independent determinations. Similarly the French observers obtained the values of $9^m\ 20{\cdot}932^{sec}$ and $9^m\ 21{\cdot}029^{sec}$, showing a difference of $\cdot097^{sec}$.

That is, the first girdle of the world closed within 84 feet. Apparently the weakest link in the girdle is the arc, Madras-Singapore, since no observations for personal equation were made at the time by Lieut. Commander C. H. Davis and Lieut. S. A. Norris, the observers respectively at Madras and Singapore.

However in the United States Navy Report quoted, Lieut. Commander F. M. Green says, p. 18, 'By means of the repeated use of the personal equation machine of Professor Eastman, at the Naval Observatory, it was found that the habitual errors of the observers engaged in this measurement had all the same sign; that is, they habitually observed the transit of a star a few hundredths of a second after its occurrence, but their respective differences were so small that it seemed evident that to introduce results so minute as corrections would not increase the trustworthiness of the result.'

This is important testimony and written at the time with reference to the Madras-Singapore arc. If it does not wholly dispose of the differential personal equation involved, it gives assurance of its very small magnitude.

In Mr. Barrachi's report quoted, he is slightly in error when speaking of the above arc; he says: 'Their personal equation was continuously tested by absolute personal equation instruments, each observer being provided with one.'

The difference of longitude Madras-Singapore as determined by Davis and Norris was, after due consideration and discussion, accepted by the Australian astronomers—Ellery, Todd and Russell—for the determination of Australian longitudes.

Brisbane.—The position of the observatory here is given in the Nautical Almanac as $10^{h.}\ 12^{m.}\ 06{\cdot}40^{sec.}$ The derivation of this value becomes apparent from the following extract from the Annual Report of the Department of Public Lands for the year 1891, Queensland.

Under sub-division 'Trigonometrical Survey' the Surveyor General under date of April 8, 1892, p. 10, says: 'Additional care was bestowed upon the determination of Burketown, as opportunity was taken there, with the kind permission of Mr. Russell, the Government Astronomer of New South Wales, of bringing Sydney Observatory into the telegraphic circuit, and of thus determining, not only the longitude of Burketown, but the difference of longitude between Sydney and Brisbane, both by direct and indirect means. The results so obtained, together with a previous determination made in 1884, and a subsequent one in the present year, have been investigated both by Mr. Russell and ourselves, and are as follows:—

	m.	s.	
1884	7	16·81	diff. Brisbane-Sydney.
1891	7	16·87	
1891	7	16·88	
1892	7	16·88	

'Considering that different observers and different methods were employed upon these determinations, the resulting mean of $7^{m.}\ 16{\cdot}86^{sec.}$ must be looked upon as possessing a very high degree of accuracy, and as Brisbane is on the initial meridian from which all our differences of longitude have been reckoned, the result is very gratifying. Assuming the longitude of Sydney Observatory to be $10^{h.}\ 4^{m.}\ 49{\cdot}51^{sec.}$, and the difference of longitude between Sydney and Brisbane observations to be $7^{m.}\ 16{\cdot}86^{sec.}$, the resulting longitude of Brisbane Observatory is $10^{h.}\ 12^{m.}\ 6{\cdot}40^{sec.}$'

Through the longitude determinations of Professor Albrecht and Major Burrard, Madras has suffered a correction of $-{\cdot}185^{sec.}$, as already shown. Hence the value of Brisbane, dependent upon Madras and Sydney becomes:—

	$10^{h.}$	$12^{m.}$	$06^{s}{\cdot}215$
The Canadian value is	$10^{h.}$	$12^{m.}$	$06^{s}{\cdot}04$
Difference.... ..			$^{s}{\cdot}171 = 2''{\cdot}565 = 231$ feet.

Taking the Canadian values for Sydney and Brisbane we find the difference of longitude between these two places:—

	$7^{m.}$	$16^{s}{\cdot}757$
While the Australian value is.....	$7^{m.}$	$16^{s}{\cdot}86$
Difference..		$^{s}{\cdot}103$

It must be remarked that the above comparison is not quite as satisfactory as desired, on account of the value of the differential personal equation obtained three weeks after the longitude campaign.

Mr. T. D. Fraser laboured considerably under a mental and physical strain, on account of very serious illness in his family during the observations. He obtained little rest during the 24 hours for several weeks, and was conscious when observing that he was not in normal condition. He gave little weight to his observations at Southport, although when computed the probable error of the time determination was satisfactory, $\pm{\cdot}014^{sec.}$, the same as that for his Brisbane observations.

A chain of triangles extends southward from Brisbane to the vicinity of Southport, some fifty miles, so that it will be easy to effect a geodetic connection between the observation stations at Brisbane and Southport, and free from any uncertainty in the differential personal equation.

Doubtless Bay.—The connection between the observatory at the Cable station and the trigonometrical survey of New Zealand was made by Government Surveyor Vin-

cent J. Blake, under instructions of the Surveyor General. The triangulation was extended from Station 20 on the west side of the mouth of Mangonui river westward about two and a half miles to Station A (the magnetic station), and thence to the near-by observatory.

The geographic position of station 20 was furnished by Mr. J W. A. Marchant, Surveyor General.

We have then:-

Longitude Station 20 .	173°	31′	37″·1
Station 20 - Sta. A. ..		– 2′	24″·1
Station A..	173°	29′	13″·0
Sta. A—Observatory.. ..		–	3″·66
Observatory..	173°	29′	09″·34
	= 11h.	33m.	56·623sec.
Canadian value is..	11h.	33m.	56·146sec.
Difference..	=		·477sec. = 7″·15 = 595 feet.

It may be remarked that the position of Station 20 is dependent upon the initial station, Mt. Cook at Wellington, through a chain of triangles about seven hundred miles long. From the roughness of the country it was expedient to carry on a network of triangulation for land survey and settlement purposes, and the refinements of a primary triangulation were not aimed at.

In the closing for Wellington it will be found that the difference is ·038sec. or ″·57, and of the same sign as the above, making thereby the difference between the telegraphic determination Wellington-Doubtless Bay, and the one obtained by triangulation ·439sec., equivalent to 549 feet at the latitude of Doubtless Bay.

What was said with reference to Southport of the relative value of the longitude determination there, is equally applicable to Doubtless Bay, as the latter station occupies the same position in the series of stations with reference to personal equation as does the former.

Wellington.—The derivation of the value for the longitude of the Wellington Observatory has already been shown as:—

11h. 39m. 05·31sec.

This requires the correction of – ·185sec., the same as applied to Sydney for the adopted value of Madras, dependent upon the work of Prof. Albrecht and Major Burrard.

We have then for the value of Wellington via Madras and Sydney:—

	11h.	39m.	05·125sec.
Canadian value is..	11h.	39m.	05·087sec.
Difference..			·038sec. = ″·57

It will be noticed that the difference between the closing at Sydney and at Wellington is ·030sec., the Canadian values being in each case less than the ones via Madras. This quantity, ·030sec., apparently represents the accordance between the direct determination of the Sydney-Wellington arc in 1883 and the indirect one via Southport and Doubtless Bay in 1903.

Although observations were made for personal equation by the two observers, yet the conditions under which they were made were not the most favourable. It was impracticable to mount the portable transit at the Wellington observatory, so that the observations were all made with the Wellington instrument, Mr. T. King observing by 'eye and ear,' as is his custom, and Dr. Klotz recorded, as is his custom, electrically, in this case, however, with a specially made make-circuit key for embossing, by means of

the style, the paper fillet of the Morse register—the chronograph of the Wellington observatory. Retardation and parallax of the two styles of the register—the one for the clock and the other for the transits—were carefully determined and applied.

FINAL LONGITUDE VALUES.

Station.	Longitude.										
	Time.			Probable Error.	Arc.					Probable Error.
	h.	m.	s.	s.	°	′	″			″
Vancouver	8	12	28 368	± 050	123	07	05 529	W		± 75
Fanning	10	37	33 774	± 054	159	23	26 610	W		± 81
Suva	11	53	42 389	± 055	178	27	35 835	E		± 82
Norfolk	11	11	41 146	± 055	167	55	17 190	E		± 82
Southport	10	13	39 782	± 056	153	24	56 730	E		± 84
Sydney	10	04	49 287	± 058	151	12	19 305	E		± 87
Brisbane	10	12	06 044	± 073	153	01	30 660	E		± 99
Doubtless Bay	11	33	56 146	± 060	173	29	02 190	E		± 90
Wellington	11	39	05 087	± 075	174	46	16 305	E		± 1 12

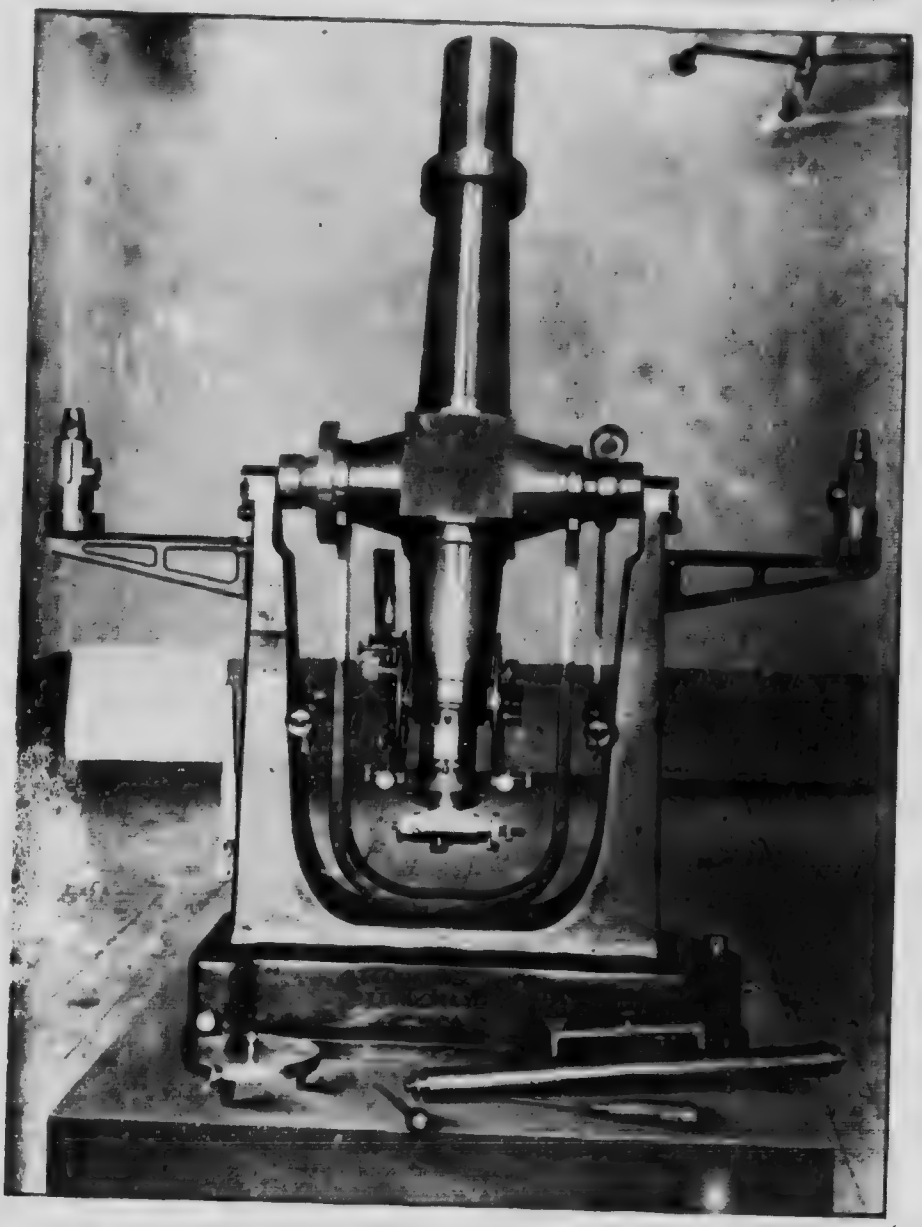


Fig. 1.—Transit.

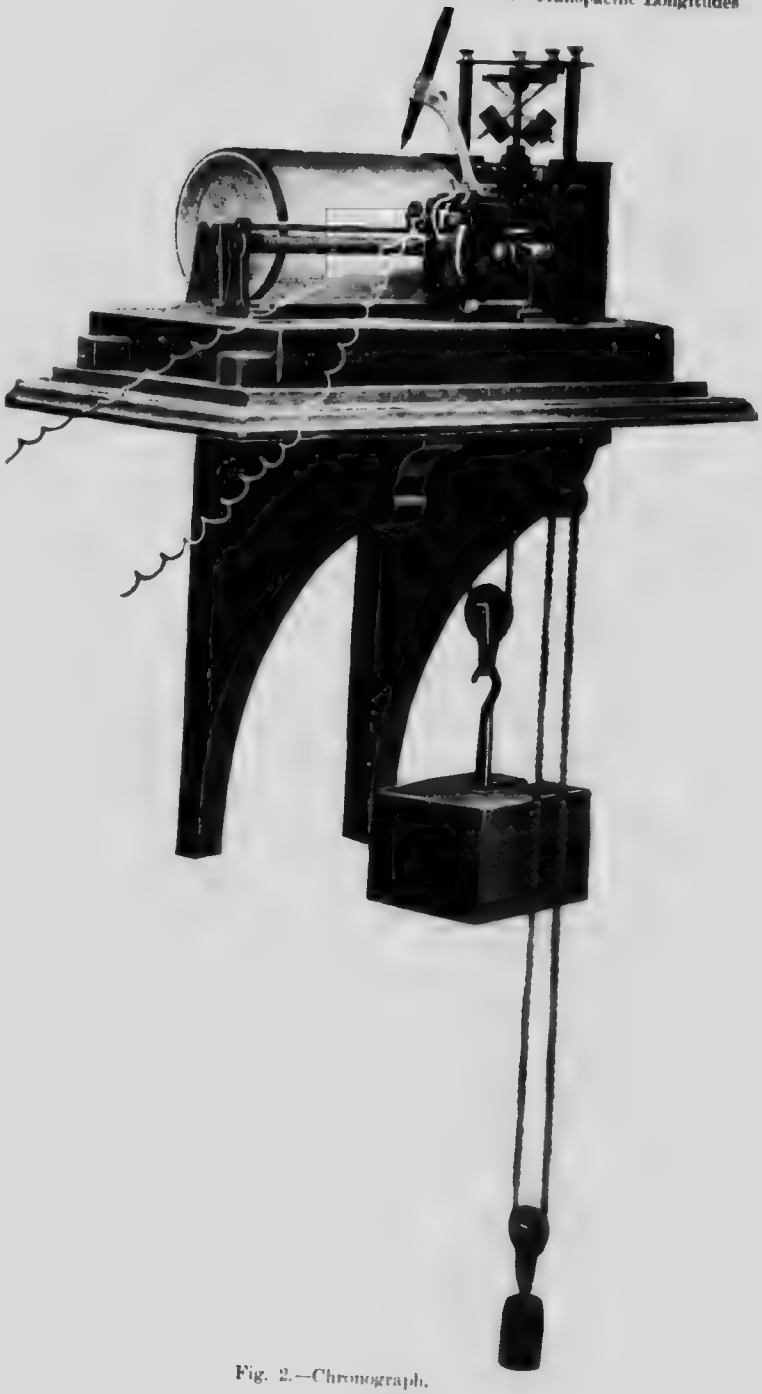


Fig. 2.—Chronograph.

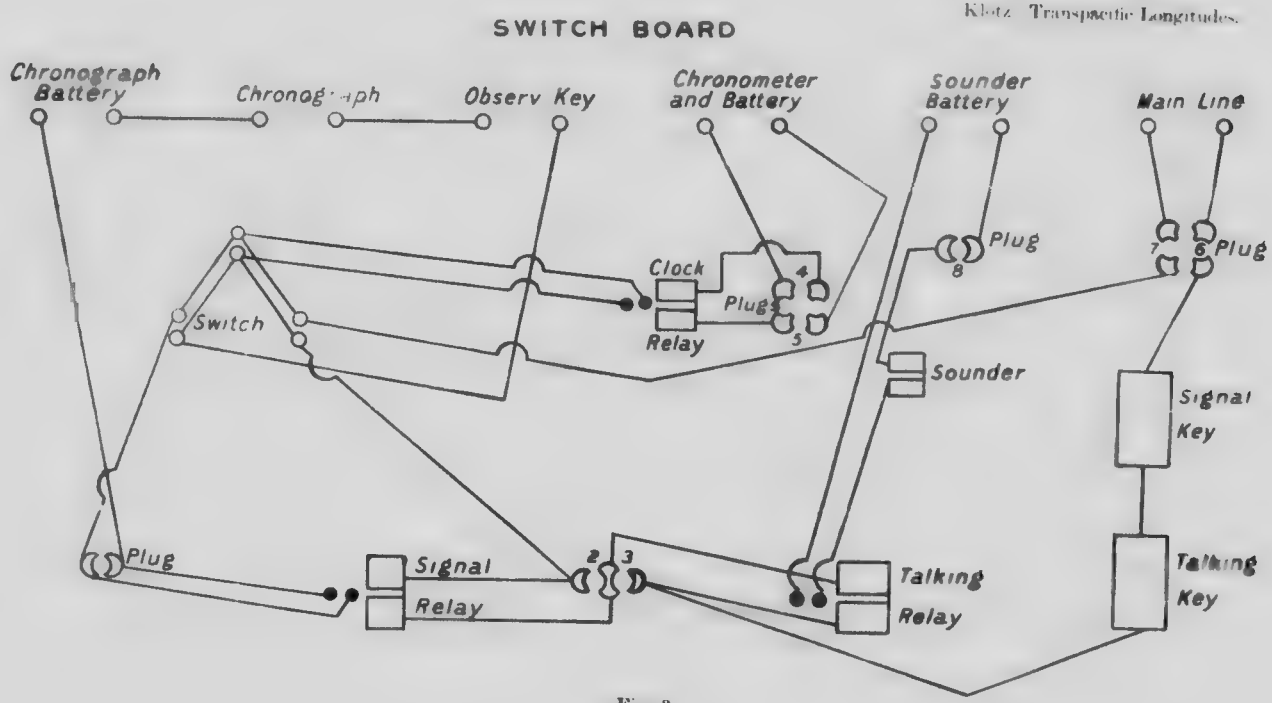

SWITCH BOARD
Chronograph Battery
Chronograph
Observ Key
Chronometer and Battery
Sounder Battery
Main Line
Plug
Plug
Clock
Plugs
Relay
Switch
Sounder
Signal Key
Plug
Signal
Relay
Talking
Relay
Talking Key

Fig. 3.

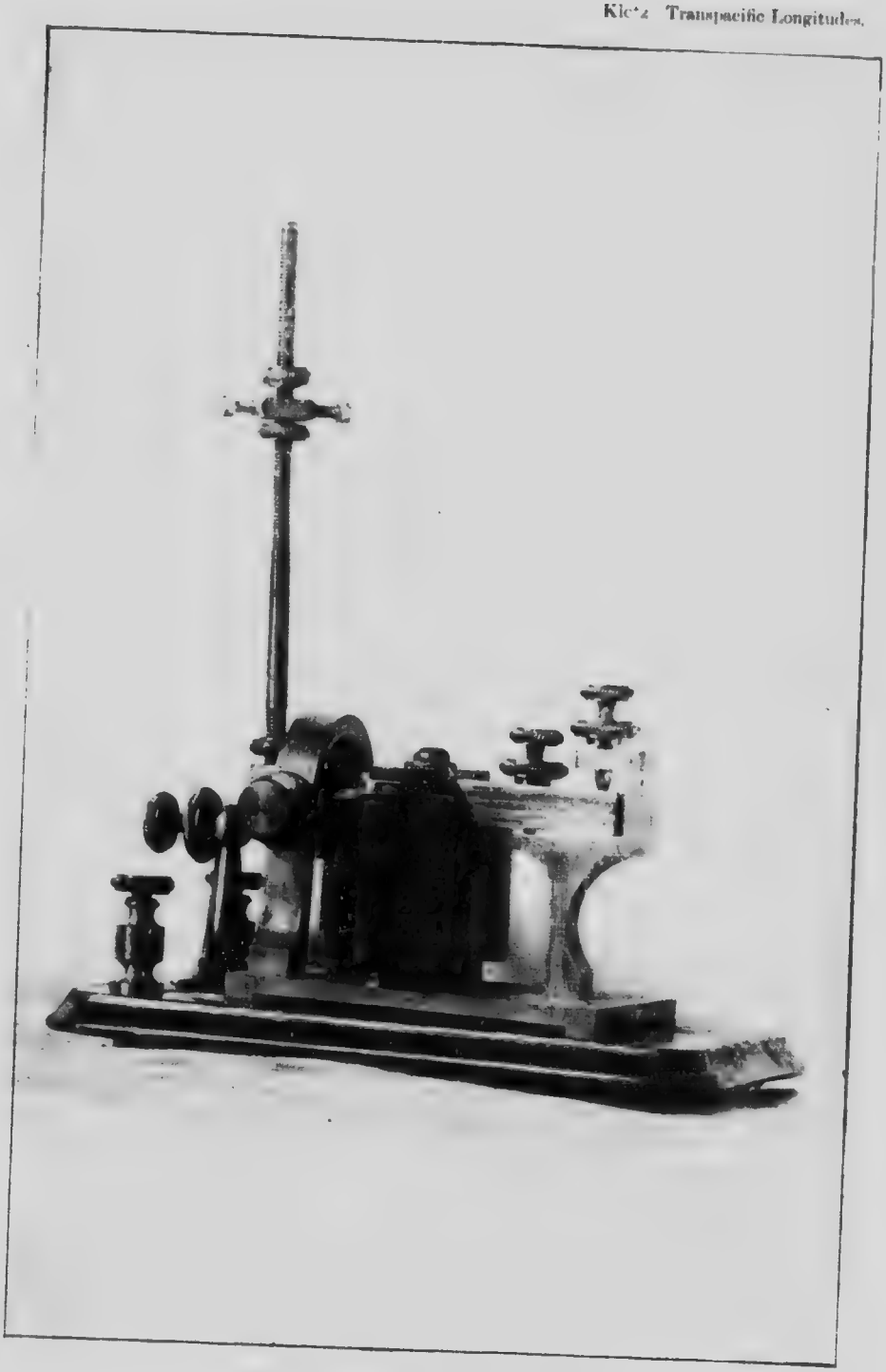


Fig. 4.—Sounder for Clock Cable Siphon.

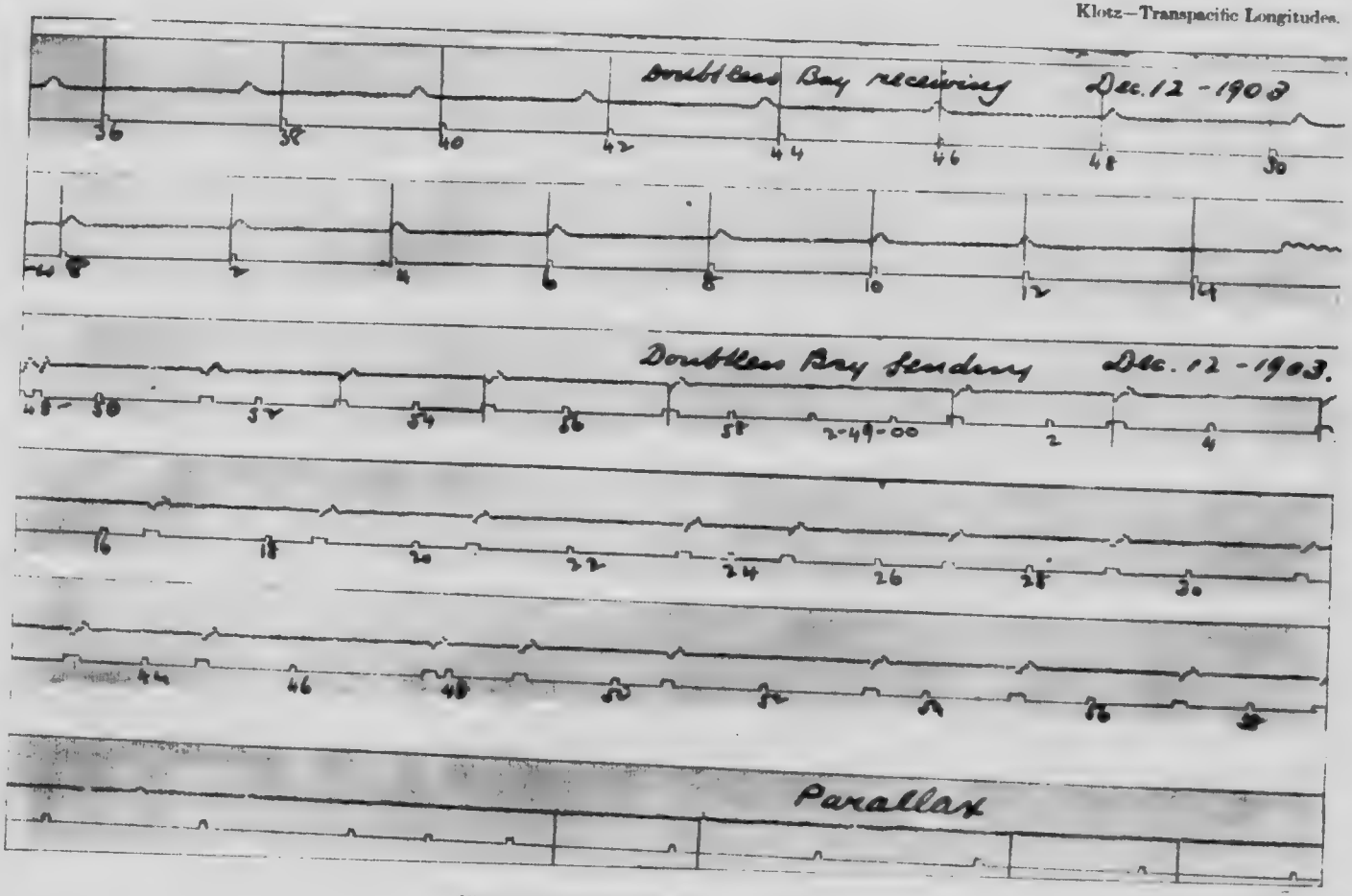


Fig. 5.—Comparison of Chronometers by Cable.

ELECTRICAL CONNECTIONS AT WELLINGTON OBSERVATORY.

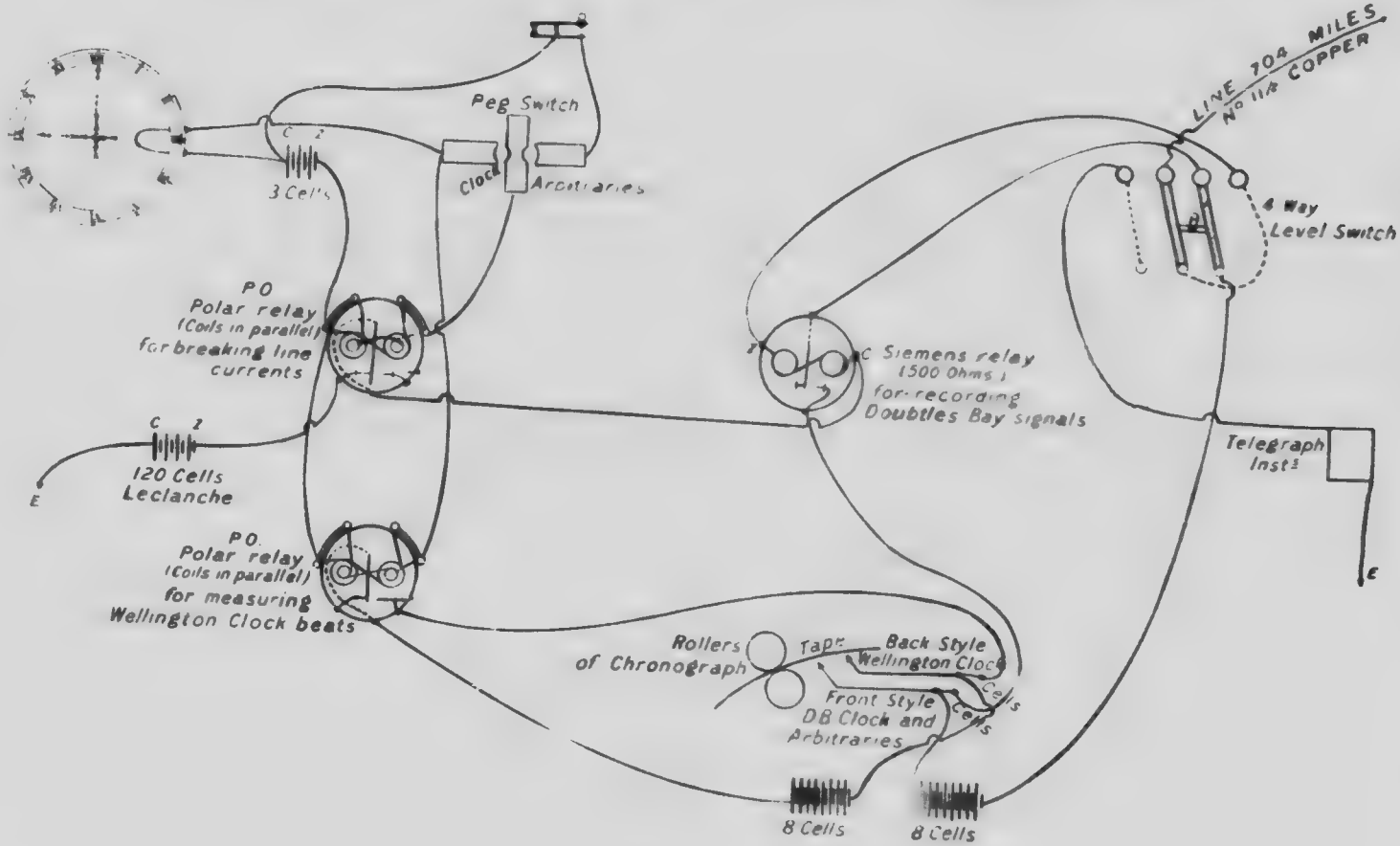


Fig. 6.

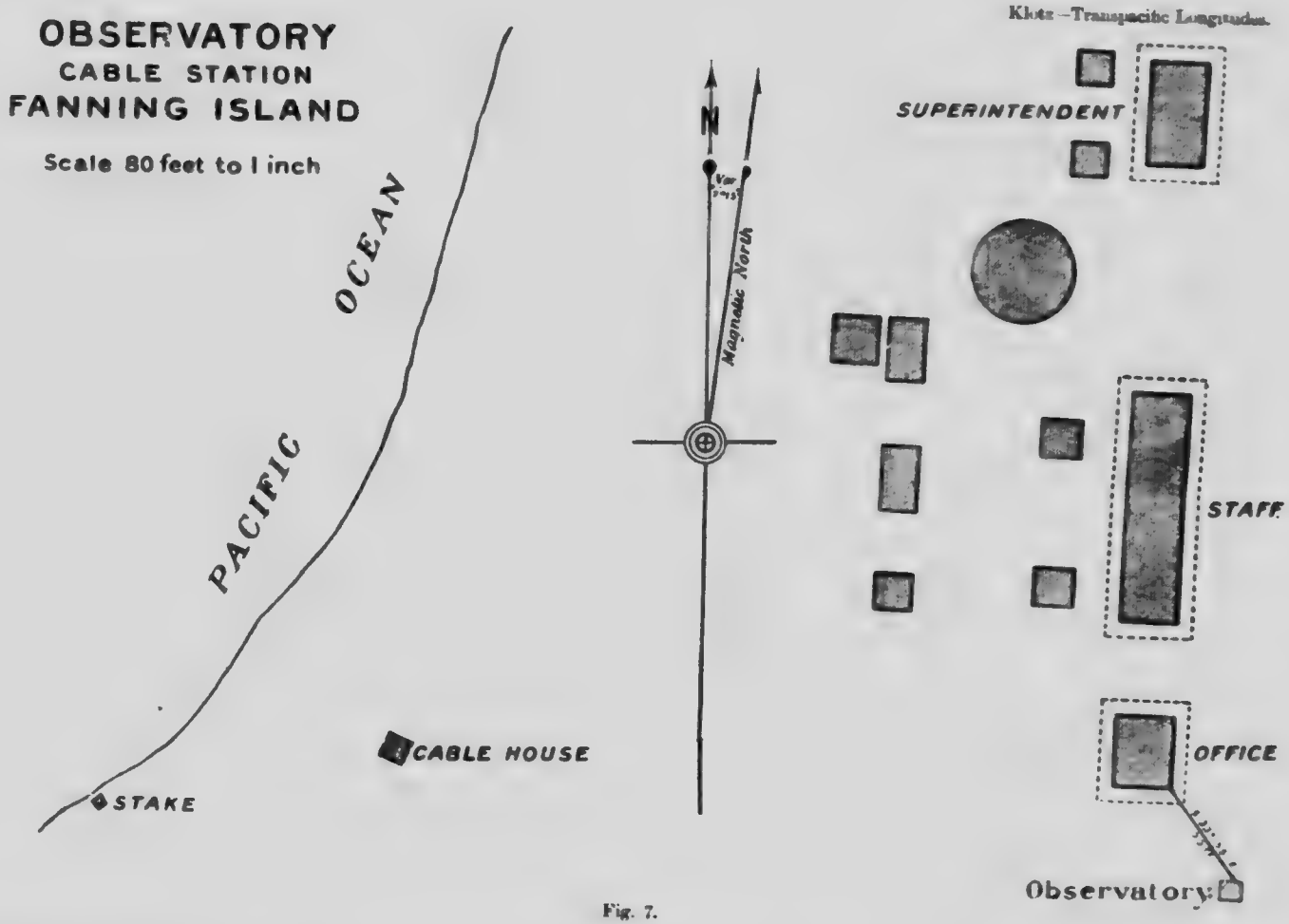
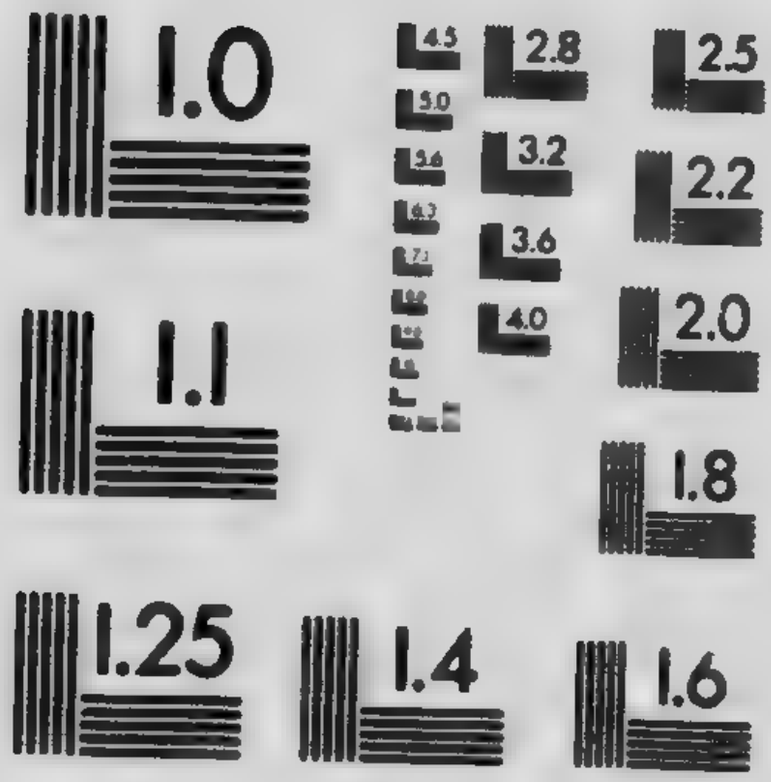

OBSERVATORY
CABLE STATION
FANNING ISLAND
Scale 80 feet to 1 inch
PACIFIC
OCEAN
STAKE
CABLE HOUSE
N
Magnetic North
SUPERINTENDENT
STAFF
OFFICE
Observatory

Fig. 7.

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



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Rochester, New York 14609 USA
(716) 482 - 0300 - Phone
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Fig. 8.—Observatory at Suva, Fiji.

Photo by Otto Klotz

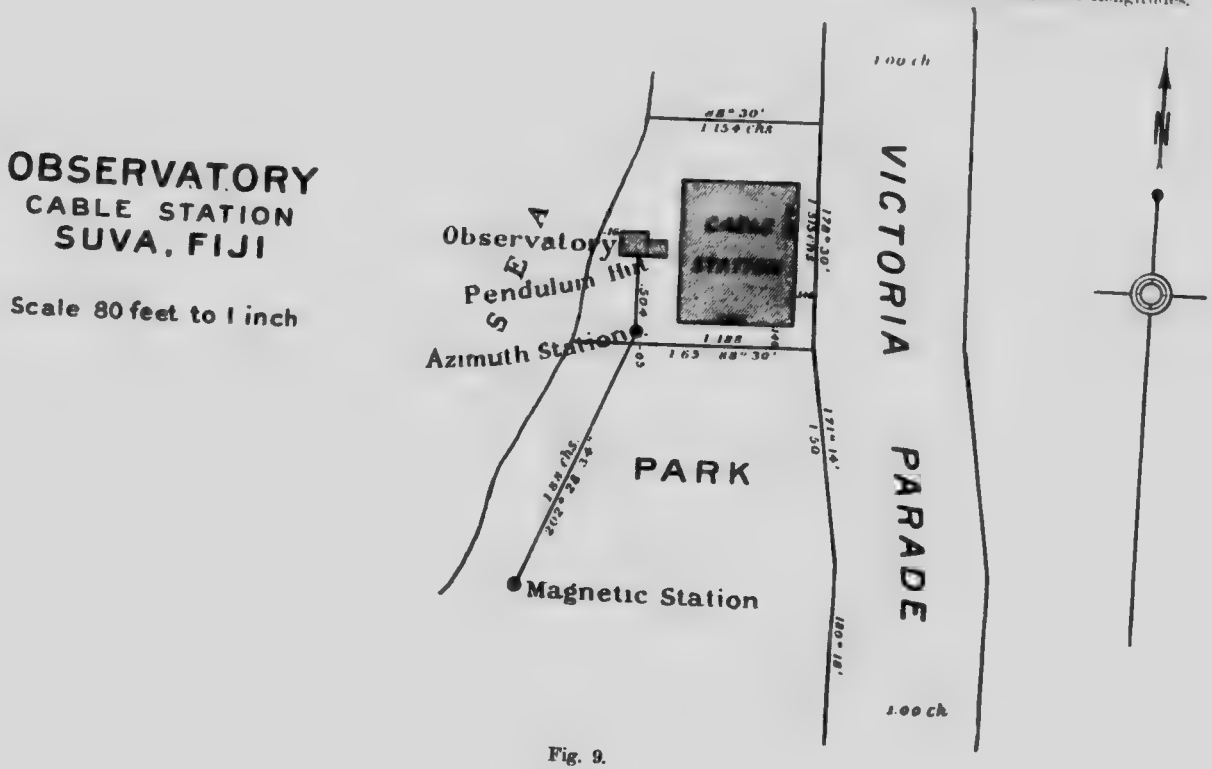

OBSERVATORY
CABLE STATION
SUVA, FIJI
Scale 80 feet to 1 inch
Observatory
Pendulum Hut
Azimuth Station
Magnetic Station
PARK
VICTORIA PARADE
CABLE STATION
N

Fig. 9.

Fig. 10 Pacific Cable Station, Suva, Fiji.

Photo by Otto Klotz.

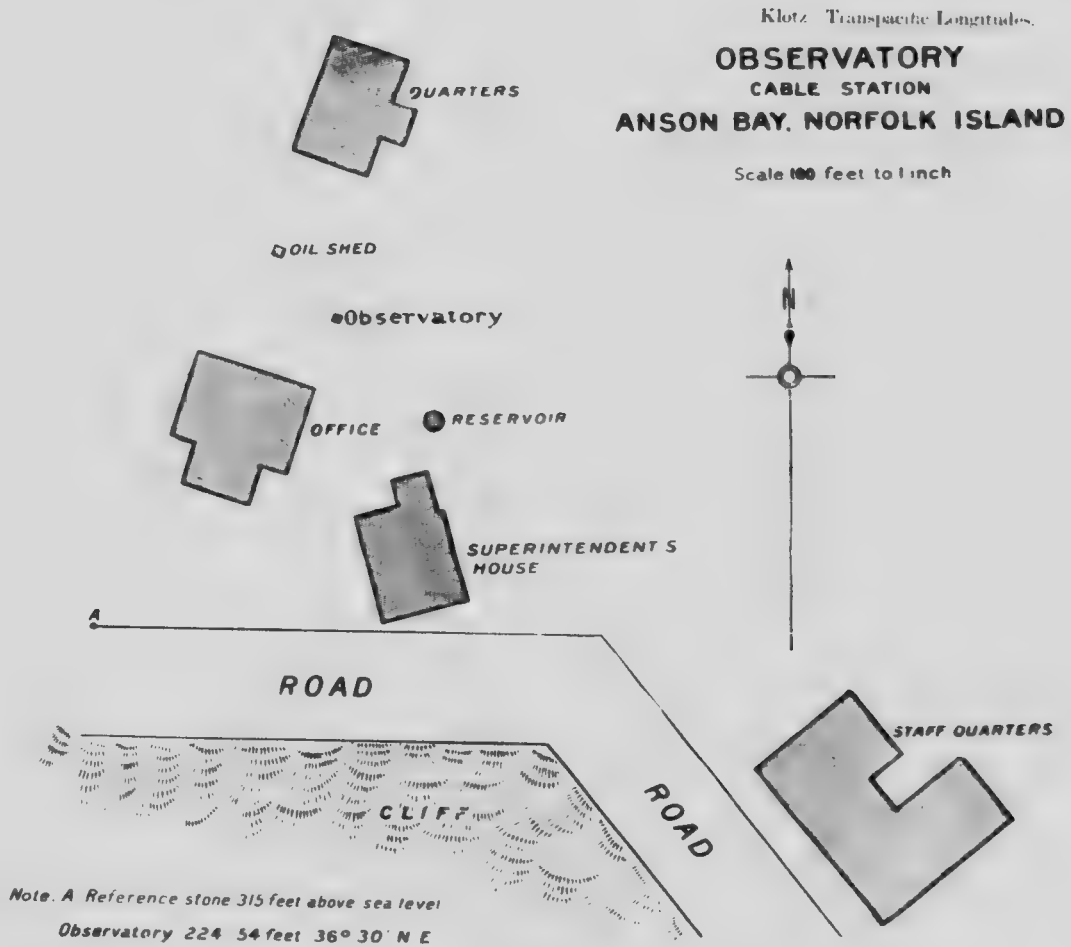

OBSERVATORY
CABLE STATION
ANSON BAY, NORFOLK ISLAND
Scale 100 feet to 1 inch
QUARTERS
OIL SHED
Observatory
OFFICE
RESERVOIR
SUPERINTENDENT'S HOUSE
A
ROAD
ROAD
CLIFF
STAFF QUARTERS
N
Note. A Reference stone 315 feet above sea level
Observatory 224 54 feet 36° 30' N E

Fig. 11.

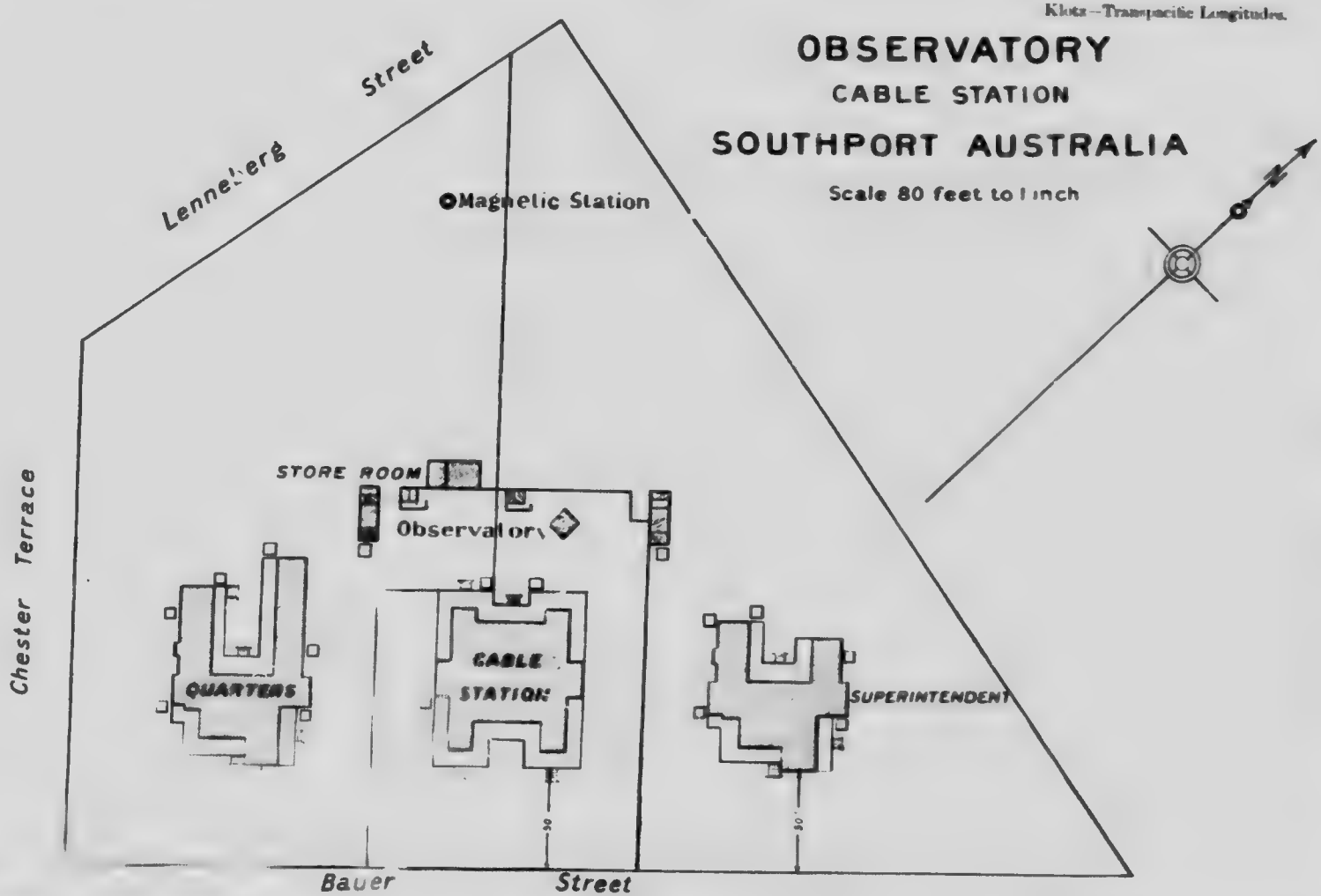

OBSERVATORY
CABLE STATION
SOUTHPORT AUSTRALIA
Scale 80 feet to 1 inch
Magnetic Station
Lennelberg Street
Chester Terrace
Bauer Street
STORE ROOM
Observatory
QUARTERS
CABLE STATION
SUPERINTENDENT
30
30

Fig. 12.

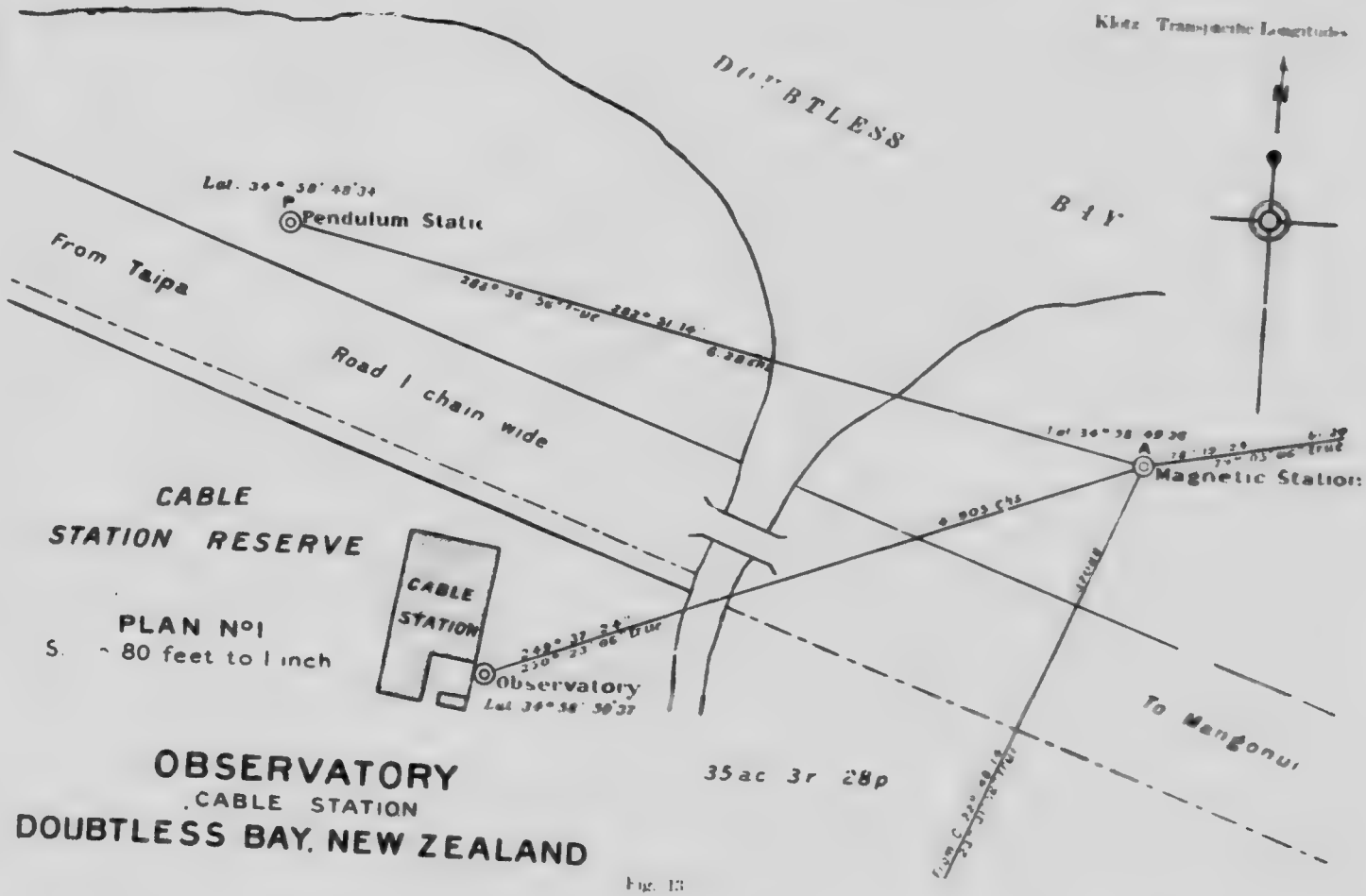
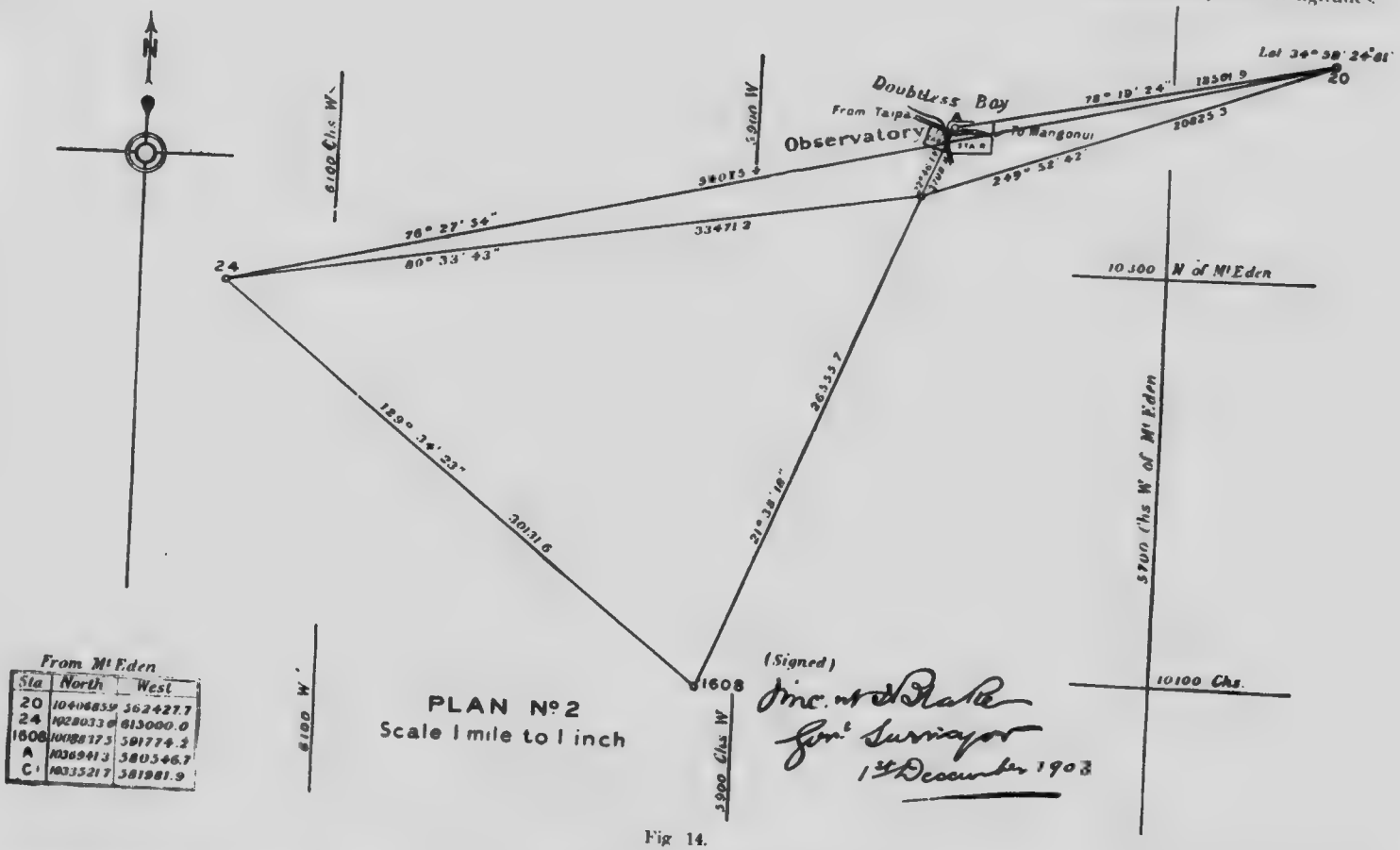

Klatz Transportable Longitudes
DOUBTLESS
BAY
Lat. 34° 58' 48"34
Pendulum Static
From Taipa
Road 1 chain wide
Lat 34° 58' 09"26
Magnetic Station
CABLE
STATION RESERVE
PLAN No1
S. - 80 feet to 1 inch
CABLE
STATION
Observatory
Lat 34° 58' 50"37
To Mangonui
35ac 3r 28p
OBSERVATORY
CABLE STATION
DOUBTLESS BAY, NEW ZEALAND

Fig. 13

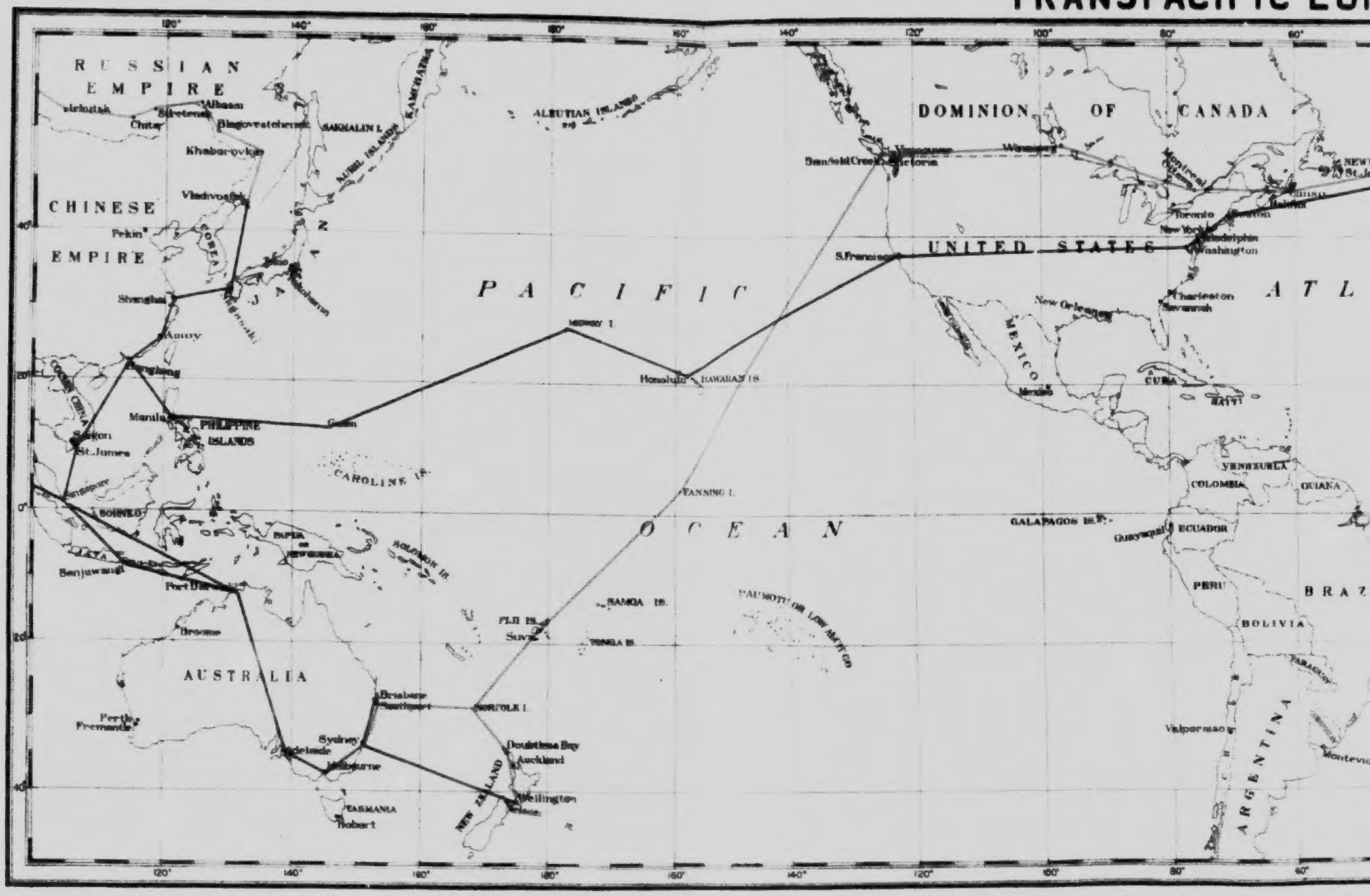


From Mt Eden

Sta	North	West
20	10406859	362427.7
24	10280330	615000.0
1608	10088175	591774.2
A	10369413	580546.7
C	10335217	581981.9

Fig 14.

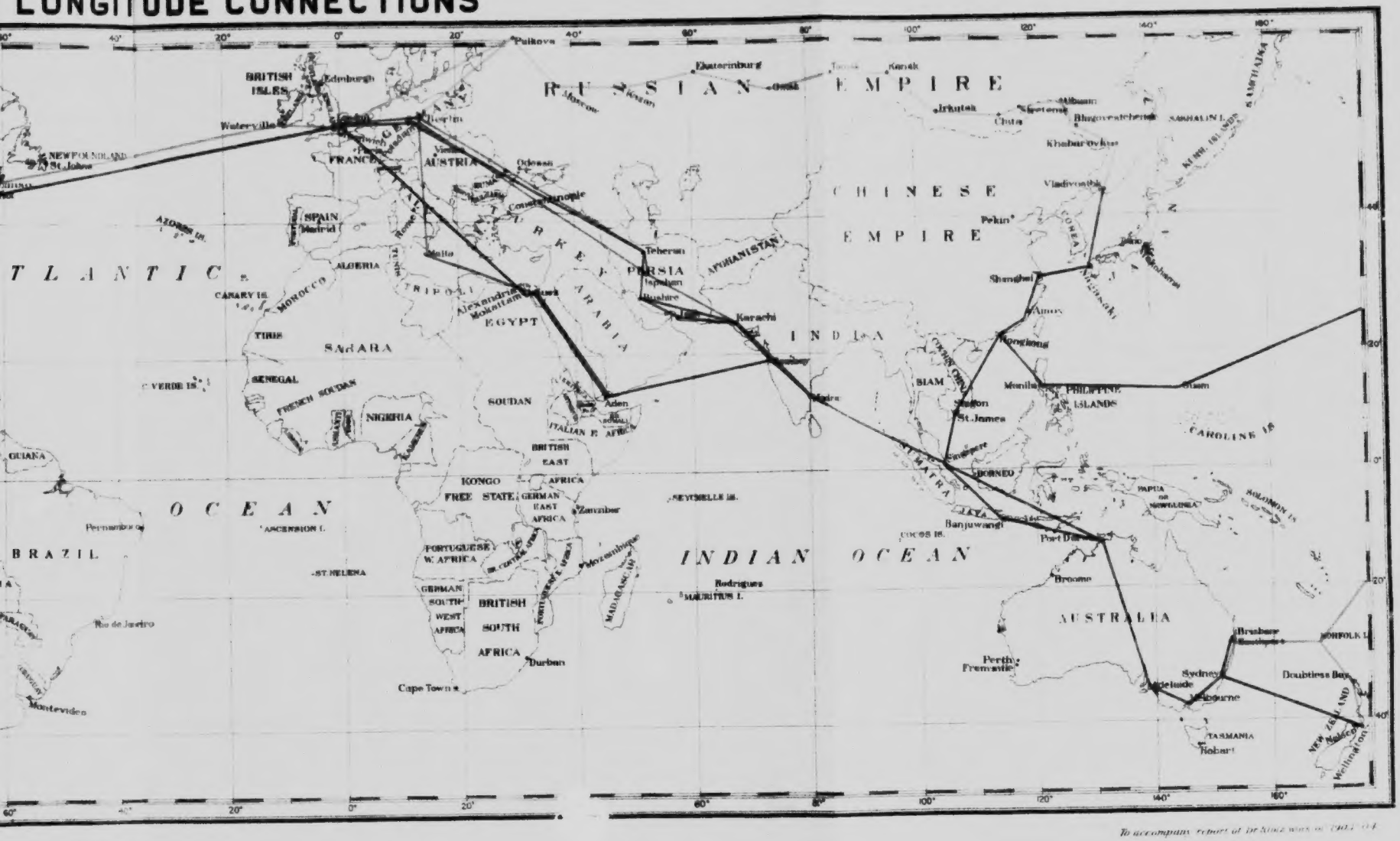
TRANSPACIFIC LON



James White, F.R.G.S. Geographer

CANADIAN ARCS
ENGLISH ,,
INDIAN ,,
AUSTRALASIAN ,,

LONGITUDE CONNECTIONS



To accompany report of Dr King, [illegible]